THE EVOLUTION OF THE EUCALYPTS IN RELATION TO THE COTYLEDONS AND SEEDLINGS.

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(Plates xxxviii.-lxix.)

Introductory.—Although so much work has been done in elucidating the botanical, chemical, industrial, and other relations of the various species of Eucalyptus, the subject of the seedlings, and especially of the form of the cotyledon-leaves, and the part the latter have taken in the evolution of the genus, has received scant attention. Our two main contributions, so far, have been from Lubbock, in his "On Seedlings," in which the seedlings of ten species are described; and from Baron von Mueller, in his " Eucalyptographia," in which he gives drawings of the cotyledons of twenty species; but some of these are far from accurate, especially in the case of *E. amygdalina* and *E. globulus*. In this research, I have investigated the seedlings of nearly 150 species, and so have been able to compare one with another, and to trace the development of the higher from the more primitive forms, and gain an idea of the influences which brought this about.

I am under a deep debt of obligation to Mr. R. T. Baker, F.L.S., for supplying seeds that were botanically correct, and for identifying the species where seeds were collected by myself; to Mr. H. G. Smith, F.C.S., for help and advice, and to Mr. T. C. Roughley, of the Technological Museum, Sydney, for the excellent series of photographs of the mounted seedlings taken by him. The seeds of most of the Western Australian species were obtained from Mr. J. Staer, and so I have to rely on his naming of them. Those from him were *E. calophylla*, *E. cornuta*, *E. diversicolor*, *E. eudesmioides*, *E. gomphocephala*, *E. leptopoda*, *E. Lehmanni*, *E. loxophleba*, *E. marginata*, *E. occidentalis*, *E. perfoliata*, *E. platyphylla*, *E. polyanthema*, *E. redunca*, *E. salubris*,

E. striaticalyx, and *E. Todtiana*. Professor Ewart, of Melbourne, kindly supplied *E. Muelleriana*; and Mr. R. H. Cambage, *E. Moorei*.

The seeds were planted in boxes, in ordinary potting soil consisting of a mixture of sand, leaf-mould, and loam; and were covered with a mulch of tan-bark. Germination usually took place at the end of a week, though often stray seedlings would appear a week or fortnight later, especially if cool cloudy weather succeeded hot sunny conditions. Sometimes seeds, though known to be fresh and, therefore, supposedly fertile, failed to germinate at all. In other cases, a few germinated, but chemical and physical conditions seemed to be adverse, and it was impossible to grow them to any size. Notable among these, were *E. Dawsoni*, *E. camphora*, *E. fastigata*, and *E. dextropinea*. In other instances, the seed had been kept so long, that most, if not all, the fertile seeds had perished. It must be remembered that most of the Eucalypts have specialised in their liking for a particular soil and certain climatic conditions for unknown ages, and unless they can get these to their liking, they do not thrive. September appears to be the best month in which to plant.

The keeping qualities of Eucalyptus seeds in a dry state.

This faculty is very marked in most of the species. The seeds used in this research were all grown in the soil, but Professor Ewart, of Melbourne, by soaking in water, then placing on filter paper in glass dishes in a germinating chamber, had 6·6 % of seeds of *E. rostrata* germinate after keeping 37 years, 1·2 % of *E. leptopoda* after 30 years, 11% of *E. diversicolor* after 24 years, and 9% of *E. cornuta* after 22 years. With the exception of *E. calophylla*, all these have small cotyledons, and *E. leptopoda* and *E. cornuta* have deeply bifid ones. A great many of the seeds I used were obtained from the specimen-cases of the Technological Museum, Sydney, where they had lain, after falling from the fruit on its drying, and dehiscence occurring. In many instances, only a few seeds were procurable, and most of these may not have been fertile in the first instance. If a large quantity of seed was obtained and carefully preserved, I believe Eucalyptus

seeds could be made to keep for much longer periods than found here. Seed of *E. Baileyana*, after 23 years, failed to germinate; and others that also gave no result were *E. lactea* (19 years), *E. quadrangulata* (18), *E. sideroxylon* (17), *E. melliodora* (13), *E. Muelleri* (16), *E. terminalis* (12), *E. angophoroides* (11), *E. vitrea* (12), *E. dextropinea* (13 and 18), *E. Dawsoni* (13), *E. hæmastoma* (16), *E. fraxinoides* (13), *E. acaciæformis* (14), *E. Luehmanniana* (19), *E. fastigata* (13), *E. pyriformis* (21), *E. albens* (12), and *E. tessellaris* (12 years). On the other hand, *E. Risdoni* (9 years), *E. carnea* (11), *E. Stuartiana* (10), *E. ovalifolia* (12), *E. Woollsiana* (8), *E. pendula* (11), *E. hemilampra* (9), *E. punctata* (16), *E. umbra* (6), *E. viridis* (11), *E. paludosa* (13), *E. trachyphloia* (18), *E. Rossii* (7), *E. pulverulenta* (10), *E. Baeuerleni* (10), *E Macarthuri* (8), *E. nigra* (13), *E. goniocalyx* (13), *E. conica* (11), *E. camphora* (12), *E. gracilis* (8), *E. Planchoniana* (11), *E. intertexta* (10), *E. Morrisii* (11), *E. aggregata* (13), *E. dealbata* (12), *E. marginata* (7), *E. affinis* (10), *E. hæmastoma* var. *micrantha* (16), and *E. obliqua* (18 years), all germinated after such prolonged periods of preservation. That seeds of *E. obliqua* and *E trachyphloia* should keep 18 years, and *E. hæmastoma* var. *micrantha* and *E. punctata* 16 years, is a remarkable testimony to the power of the seeds of this genus of withstanding dessication for prolonged periods.

Much has been written, especially by foreign observers, as to "the variability of Eucalyptus under cultivation." I have not found this to be so, even after growing seedlings of the same species from widely separated localities. They have invariably come true. We may get some fluctuations or slight departures from the normal, but when species have been botanically identified by an expert, who knows the Eucalypts, this supposed variability has not been found to occur. Many of the mistakes have been due to trusting to the vernacular names of collectors, who had a very imperfect botanical knowledge. Again as to hybridism, I have been keenly on the alert to discover instances of this, but, after examining thousands of seedlings from different species, I have not seen one single instance of it so far.

Although the seedlings of many species differ so markedly from one another, that they could be detected at once, I have

hitherto found them uniform throughout, though there may be slight differences in size, vigour, etc. Still, knowing that hybridism has actually been proved in the genus *Acacia* (Proc. Linn. Soc. N. S. Wales, xxxv., Pt.2), of which, as of the Eucalypts, so many species occur in Australia, we may hope soon for actual demonstration of such occurring in the latter. Up to the present, though much has been said as to one species being a hybrid of two others, we have had no actual proof.

Fruits and Seeds.—In Eucalyptus, the fruit is a capsule opening at the top in three to six valves, which dehisce along their centre. In *E. phœnicea*, there are only two cells. Fruit generally many-seeded, the majority, or all but one, being sterile. In the *corymbosa*-group, of which *E. corymbosa* may be taken as the type, there is generally only one fertile seed to each cell, and this is vertically compressed, and flattened from before backwards, the hilum showing as a paler depression in the middle of the ventral surface, and the testa is frequently prolonged into a membranous appendage to aid distribution by the wind. In *E. corymbosa*, the posterior angle is keeled. In most of the other Eucalypts, the fertile seeds are more numerous, and are compressed and angled laterally, according to their position in the cell; the hilum is at the narrower inner extremity, and the larger outer extremity is rounded to the shape of the wall of the cell. The sterile seeds are light brown, narrow or linear, the fertile ones dark brown or black.

The *testa* is membranous, brown or black, and has not undergone much modification, except in the development of the aforesaid membranous appendage in the Corymbosas, and some allied northern species.

Endosperm is absent.

Embryo.—As endosperm is not present, the form of the embryo depends on the shape, size, and manner of folding of the cotyledons. The length of the petioles in the embryo depends on the distance from the junction of lamina and petiole to the superior pole of the radicle; and, in most species, is probably fairly short before germination. In *E. citriodora* and *E. maculata*, the cotyledons are almost sessile. In *E. marginata*, the

hypocotyl is subterranean, and the failure of this to elongate, by growth in germination, is compensated for by the great elongation by growth of the petioles, so as to raise the laminæ well above the ground. A similar condition obtains in *Angophora cordifolia*, where the hypocotyl is short, and the petioles long. *E. calophylla* and *E. Todtiana* also have fairly long petioles.

Radicle.—A series of sections of the seeds for microscopic examination would be necessary to give the shape and length of the radicle, and with such small seeds as the majority of the species possess, this would be difficult of accomplishment. As far as I have been able to observe, in the larger seeds, the radicle is short, thick, and truncate, resting on the lower pole of the seed from which it emerges in the *corymbosa*-group; or against the hilum, from the neighbourhood of which it emerges, in the *globulus*- and allied groups.

Cotyledon-Leaves.—Lubbock states that, in the great majority of plants, the cotyledons are entire. In the Eucalypts, however, emargination in a greater or less degree is more common, and in some species, reaches an extreme degree. As this appears to be a response to Australian xerophytic conditions, it indicates that the species with simpler, entire cotyledons are those of the more primitive type; while those, with emarginate cotyledons, are of the more evolved and developed type, and this bears out the researches on the botanical and chemical characters of the genus. Botanically and chemically, the "Bloodwood"- or *corymbosa*-group has been considered the most primitive, and to most closely approach the allied genus *Angophora*, and the seedlings bear this out. In my companion paper to this, "The Seedlings of the Angophoras," (Proc. Roy. Soc. N. S. Wales, Vol. xlvii.), I have shown that all, except *A. cordifolia*, have reniform, entire cotyledons. Those of *E. corymbosa* and its congeners are of the same form, and quite indistinguishable. The primary leaves, however, serve to separate them, as in the Corymbosas they are petiolate, and alternate after the first or second pair, in many cases becoming peltate as well. Both, however, have stellate hairs on the early leaves. After growing the seedlings of such a large number of species, and comparing them, it was seen that a very

interesting and instructive classification of them, according to size and shape of cotyledons, could be made; and that, in many instances, this tentative arrangement followed certain morphological and chemical lines in a manner hitherto unsuspected by workers on the subject of Eucalyptology. Certain species were found to adhere to the entire type of cotyledon, and in the case of the Eastern Australian Stringybarks, this adherence was very close. In other instances, there seemed a return to the primitive type of cotyledon, as in *E. dumosa* and *E. incrassata*. What species represent the prototype of the emarginate form, whether it appeared suddenly or gradually, in what part of the continent it first developed, cannot at present be told. Fuller knowledge of the seedlings of the remaining species of Eucalypts, and a consideration of their distribution, may give a key to solve the problem. However, just as we have the Corymbosas with large, entire cotyledons, so we have the group, like *E. marginata*, with large, emarginate ones; then we have the peppermint-group, with smaller cotyledons, slightly or hardly at all emarginate; then a large collection of species, all more or less emarginate, but with cotyledons gradually diminishing in size, till we get the almost minute ones of *E. rostrata* and *E. viridis*; and finally, the extremely bifid species of the *E. squamosa* type. We may thus place the Eucalypts in two great cotyledonary classes, entire and emarginate, and group them as follows.

i. *Entire Cotyledons.*

(*a*). Bloodwoods or Corymbosas, characterised by very large or medium-sized cotyledons, usually reniform in shape, and resembling those of the Angophoras, comprising *E. calophylla*, *E. perfoliata*, *E. eximia*, *E. corymbosa*, *E. trachyphloia*, *E. citriodora*, *E. maculata*, and *E. intermedia*. The primary leaves very soon become alternate, and generally peltate; they are petiolate, and covered with glandular hairs.

(*b*). Cotyledons of medium size to small, reniform, entire; primary leaves opposite, shortly petiolate, covered with glandular hairs; mainly Stringybarks, with reniform anthers.—*E. lævopinea*, *E. dextropinea*, *E. Wilkinsoniana*, *E. eugenioides*, *E. capitellata*,

E. macrorhyncha, *E. nigra*, *E. obliqua*, *E. Muelleriana*, *E. Marsdeni* (sp.nov.), *E. fastigata*, and *E. regnans*. The last-named has a smooth bark, but otherwise the seedling resembles the others.

(*c*). Cotyledons small, reniform or orbicular; leaves smooth and petiolate. *E. dumosa*, *E. populifolia*, *E. quadrangulata*, *E. polybractea*, and *E. incrassata*. It is probable that these, in undergoing reduction in size, have reverted to the primitive type as regards shape.

ii. *Emarginate Cotyledons.*

(*a*). Cotyledons large, obcordate, cuneate at base, petioles long. *E. marginata*, *E. Todtiana*, *E. meyacarpa*, and *E. santalifolia*. The last-named shades off into the following group.

(*b*). Cotyledons medium to small, emargination moderate, slight or even practically absent. Primary leaves smooth, as a rule, and sessile. In most cases, the under sides of the leaves and cotyledons are tinged deep purplish-red. Most of these species contain eucalyptol, and many of them phellandrene and piperitone. The anthers are generally reniform. This group comprises *E. Planchoniana*, *E. pilularis*, *E. acmenioides*, *E. umbra*, *E. carnea*, *E Risdoni*, *E. linearis*, *E. phlebophylla*, *E. hæmastoma*, *E. stricta*, *E. Rossii*, *E. striaticalyx*, *E. piperita*, *E. amygdalina*, *E. coccifera*, *E. vitrea*, *E. Luehmanniana*, *E. oreades*, *E. Sieberiana*, *E. Delegatensis*, *E. campanulata*, *E. Andrewsi*, *E. coriacea*, *E. dives*, *E. radiata*, *E. apiculata*, *E. virgata*, *E. obtusiflora*, *E. stellulata*, and *E. Moorei*.

(c^1) Cotyledons smaller, more or less transversely oblong, emargination moderate or very slight; primary leaves generally smooth, petiolate, or sessile, the latter often glaucous. In this group may be placed the Ironbarks and most of the Boxes, with anthers opening by pores; the remainder mostly have parallel anthers. In this group are *E. botryoides*, *E. saligna*, *E. robusta*, *E. Baeuerleni*, *E. propinqua*, *E. microcorys*, *E. paniculata*, *E. crebra*, *E. sideroxylon*, *E. melanophloia*, *E. siderophloia*, *E. albens*, *E. hemiphloia*, *E. resinifera*, *E. punctata*, *E. Muelleri*, *E. fasciculosa*, *E. longifolia*, *E. diversicolor*, *E. leucoxylon*, *E* sp.nov. (R. T. Baker), *E. patentinervis*, *E. viminalis*, *E. saligna* var. *pallidivalvis*, *E. Perriniana*, *E. Gunnii*, *E. Stuartiana*, *E. cinerea*,

E. Smithii, E paludosa, E. lactea, E. melliodora, E. sideroxylon var. *pallens,* and *E. acervula.*

(c^2). Cotyledons very small, transversely oblong or triangular, emargination slight or practically absent. Primary leaves generally smooth and petiolate. Where the petiole is so small, it is sometimes almost impossible to know whether to put some of these in this group or in i.(*c*). Comprised in this group are *E. Macarthuri, E. rubida, E. pulverulenta, E. Morrisii, E. maculosa, E. odorata, E. Behriana, E. dealbata, E. ovalifolia,* E. sp.nov., (R. T. Baker), *E. Woollsiana, E. conica, E. intertexta, E. Fletcheri, E. nova-anglica, E. viridis, E. affinis, E. camphora, E. aggregata, E. rostrata, E. acaciæformis, E. Rodwayi, E. tereticornis* var. *linearis, E. tereticornis, E. Parramattensis, E. Bosistoana,* and *E. polybractea.*

(c^3). Cotyledons larger than in ii.(c^1), more deeply emarginate, lobes obovate-oblong, obtuse, divergent. In many, the primary leaves are sessile and glaucous. It will be seen that this group shades off from (c^1), just as (c^2) may be taken to shade off from (c^1) in the other direction. Comprised in it are *E. cudesmioides, E. gomphocephala, E. Lehmanni, E. cosmophylla, E. corynocalyx, E. hemilampra, E. elæophora, E. goniocalyx, E. urnigera, E. unialata, E. Maideni, E. globulus,* and *E.* sp.nov.,(R. T. Baker).

(*d*). Cotyledons deeply bifid, the emargination being carried to an extreme degree; hence they may be termed Y-shaped. The lobes or limbs of the Y are finally so reduced as to be merely linear. The primary leaves are generally opposite, and linear or linear-lanceolate. This comprises *E. cornuta, E. polyanthema, E. occidentalis, E. salubris, E. leptopoda, E. loxophleba, E. redunca, E. gracilis, E. pendula, E. calycogona, E. uncinata, E. cneorifolia, E. oleosa, E. salmonophloia,* and *E. squamosa.*

Description of Eucalyptus Seedlings.

i. Cotyledons entire.

(*a.*) Cotyledons large to medium, mostly reniform; primary leaves generally with stellate hairs, frequently peltate.

E. calophylla R.Br. (Plate xxxviii., fig.1).—My results agree with Lubbock's. Note should be made of the large reniform-

orbicular cotyledons, the largest so far known among Eucalypts, and larger than any in the Angophoras; the petioles are really longer than are shown in Lubbock's diagram, and the leaves alternate from the beginning. The incipient emargination mentioned by Lubbock is usually due more to separation and splitting during germination. The stellate hairs on the petioles of cotyledons are unusual. The earlier leaves tend to become peltate for a few pairs, a character they afterwards lose. The leaves are very like those of *E. corymbosa*. It is noteworthy that this species and *E. ficifolia* are the only ones of the Corymbosa- or Bloodwood-group found in South-western Australia. (Pl. lxix., fig.4).

E. corymbosa Sm. (Plate xxxviii., fig. 4).—Hypocotyl erect, terete, glabrous, 1·2 cm. long. Cotyledons 1·1 × 0·8 cm., petiole 0·7 cm., entire, reniform, glabrous, purplish on under surface, sometimes with a small apical point. Stem erect, terete, herbaceous, ultimately woody, greenish but drying to red, covered with glandular hairs. Leaves alternate, petiolate, entire, ovate to oval; lateral veins rather oblique, open; petioles and laminæ covered with glandular hairs. In the very young stage, the leaves have a purplish tinge. First pair, 1·3 × 0·5, petiole 0·7; second pr., 2·5 × 0·9, petiole 1; third pr., 3·2 × 1·2, petiole 1 cm. First internode 2·5, second internode 1·2 cm. Leaves assume a peltate character, which they lose again. Later leaves are coriaceous, smooth and shining, large and broad, with lateral veins parallel, more closely set and almost at right angles to the midrib. (Pl. lxix., figs.3, A, D).

E. eximia Schau. (Plate xxxix., fig.1).—Cotyledons resemble those of *E. corymbosa*, but are slightly smaller. Internal concave border shallower, petiole shorter. Leaves entire, alternate, obtuse, ovate, petiolate. First pr. 1·4 × 1, petiole 1·1; second pr. 2·7 × 1·5, petiole 0·7 cm. Stem and leaves covered with glandular hairs. After the third pair, the leaves become peltate for a few pairs. They have a peculiar bluish-green appearance. Venation a little oblique and open. Leaves broader, but shorter than in *E. corymbosa*.

E. ficifolia F.v.M.—*See* Lubbock's "On Seedlings."

E. trachyphloia F.v.M. (Pl. xxxviii., fig.3).—Cotyledons reniform, entire, glabrous, 0·7 × 0·45, petiole 0·3 cm. Leaves oval then lanceolate, opposite, soon alternate and vertical, obtuse, entire, petiolate. Stem and leaves covered with glandular, stellate hairs. Stem erect, terete, green. The cotyledons are smaller than in *E. corymbosa*, corresponding with the smaller fruit. This is interesting, as the species occurs at Narrabri, where the climate is very hot, and much drier than on the coast. This reduction is to meet the hot, drier climate. The first leaves, too, are smaller, first pr. being 0·7 × 0·4, petiole 0·3; second pr. 0·9 × 0·6, petiole 0·3; third pr. 1 × 0·4, petiole 0·4; fourth pr. 1·5 × 0·9, petiole 0·6 cm. Peltate leaves not seen so far as grown.

E. intermedia R. T. Baker (Pl. xxxviii., fig.2). – Hypocotyl terete, glabrous, 0·6 cm. Cotyledons reniform, lighter green on under surface, very slightly emarginate, 1 × 0·6, petiole 0·4 cm. Leaves entire, opposite, soon alternate, lanceolate, obtuse, tapering to petiole, lighter colour on under surface. First pr. 1·2 × 0·6, petiole 0·2; second 1·5 × 0·8, petiole 0·4; third 3 × 1, petiole 0·4 cm. Stem and leaves covered with glandular hairs; peltate leaves not observed. Mr. Baker rightly separated this species from *E. eximia* and *E. corymbosa*. It differs in one very important matter in that, in many cotyledons, there is slight but distinct emargination. These are also smaller. The leaves, too, are distinct. The lateral veins are transverse, and the intramarginal vein close to the edge.

E. perfoliata R.Br. (Pl. xxxix., figs.2-3). – Seed, supplied by Mr. J. Staer, gave seedlings of two kinds. In one, the cotyledons were larger, 1·5 × 0·9, petiole 0·5 cm., reniform, entire, glabrous, dark green. Leaves oval, obtuse, opposite. In the other, cotyledons not so broad, 1·3 × 0·9, petiole 0·3 cm., laminæ purplish on under surface. Leaves ovate, not so obtuse. In both cases, leaves shortly petiolate, and they and stem covered with glandular hairs.

E. citriodora Hook. (Pl. lxv., fig.1; Pl. lxix., fig.2). – Hypocotyl glabrous, terete, 0·9 cm. long. Cotyledons orbicular-reniform, almost sessile, entire, sometimes with apical tooth, glabrous, 0·7 cm. in diameter. Leaves ovate, then lanceolate and peltate, obtuse,

alternate, petiolate, drying a yellowish-brown, citron-scented. First pr. opposite, 1 × 0·3, petiole 0·2; second 1·2 × 0·5, petiole 0·4; third 1·8 × 0·7, petiole 0·4 cm. Stem and leaves rough, with short glandular hairs.

E. maculata Hook. (Pl. xliv., fig.1).—Hypocotyl erect, terete, glabrous, 0·9 cm. long. Cotyledons as in *E. citriodora*, but smaller and more orbicular, subsessile, entire, 0·65 cm. in diameter. Leaves ovate, obtuse, alternate, petiolate, then peltate for a few pairs, becoming again petiolate, dark green. Venation oblique, with often two main lateral veins springing from near petiole. (This is seen, too, in *E. citriodora*). Leaves and stem have glandular hairs. These two species are of special interest. *E. citriodora* has sometimes been put as a variety of *E. maculata*, but should not. However, they raise a point I wish to emphasise, that when, in allied species, the fruits closely resemble each other or are practically identical, the cotyledons also resemble one another. This obtains specially in these two species, and their being subsessile, separates them from all other species of Eucalypts, yet they differ in primary leaves, oils, bark, timber, habitat, etc. The colour of *E. citriodora*, on drying, is also worthy of comment, and is probably due to its chemical composition. The peltate leaves emphasise their relation to the Bloodwoods. The primary leaves of *E. maculata* have some resemblance to those of *E. eximia*.

i.(*b*). Eucalypts with reniform, entire cotyledons; "stringy" bark; shortly petiolate primary leaves with glandular hairs. Though the cotyledons are entire and the leaves hairy, the group differs from the Bloodwoods in the primary leaves being opposite and shortly petiolate.

E. lævopinea R. T. Baker (Pl. xl., figs.1-2).—Hypocotyl terete, glabrous, reddish, 0·7 cm. long. Cotyledons obtusely quadrilateral, reniform or cuneate at base, entire, glabrous, reddish underneath, 0·9 × 0·8, petiole 0·3 cm. Leaves broadly lanceolate, subacute then acute, opposite, shortly petiolate, margin waved or slightly serrate, venation pinnate. First pr. 2 × 0·9; second 3·5 × 1·5 cm. Stem and leaves with glandular hairs. Stem terete, reddish. First internode 0·7; second 0·8; third 2 cm.

The later leaves, tenth to fifteenth pairs, are broad, coriaceous, sessile, often cordate at base, acute, alternate.

E. dextropinea R. T. Baker (Pl. xl., fig.4).—Hypocotyl terete, glabrous, reddish, 0·6 cm. Cotyledons smaller than in *E. lævopinea*, reddish-purple on under side, sometimes slightly emarginate, 0·8 × 0·7, petiole 0·4 cm. Leaves broader than in *E. lævopinea*, purplish-red on under surface, dark green, subsessile, opposite, obtuse, margin waved or serrated, ovate-lanceolate, veins pinnate and looped. First pr. 2·1 × 1; second 3·6 × 1·5; third 4 × 1·8 cm. First internode 0·4, second 0·5, third 0·6 cm. Stem terete, greenish, and it and leaves covered with stellate hairs.

E. Wilkinsoniana R. T. Baker (Pl. xli., fig.2).—Hypocotyl erect, terete, glabrous, 1 cm. Cotyledons smaller than in *E. lævopinea*, reniform, entire, glabrous, 0·4 × 0·3, petiole 0·3 cm. Leaves ovate or oval, petiolate, margin serrate or sinuate, obtuse, opposite, venation pinnate. First pr. 1·5 × 0·6, petiole 0·4; second 3 × 1·2, petiole 0·5; third 3·3 × 1·5, petiole 0·4 cm. Stem and leaves covered with glandular hairs. First internode 0·9, second 1·8, third 1·6 cm. Leaves, especially from fourth to seventh pairs, have margins much more sinuate than in *E. nigra*.

E. macrorhyncha F.v.M. (Pl. lviii., fig.6).—Hypocotyl as in other members of the group. Cotyledons as in *E. Wilkinsoniana*, only very dark purple on under surface. Leaves ovate-lanceolate, obtuse, opposite, petiolate, margin sinuate. First pr. 2 × 0·9, petiole 0·6; second 3 × 1·8, petiole 0·5 cm. First internode 1·2, second 2·5, third 1·8 cm. Stem and leaves covered with glandular hairs.

E. capitellata Sm. (Pl. lviii., fig.7).—Cotyledons as in *E. Wilkinsoniana*, only rather cuneate at base, petiole longer. Leaves much like those of *E. macrorhyncha*, only narrower.

E. nigra R. T. Baker (Pl. lix., fig.1).—Cotyledons and leaves closely resemble those of *E. Wilkinsoniana*, but leaves not so obtuse and rounded at apex as in that species.

E. eugenioides Sieb. (Pl. xliii., fig.2).—Cotyledons reniform, smaller than in *E. Wilkinsoniana*, 0·3 × 0·25, petiole 0·3 cm. Leaves narrower than in the other Stringybarks, lanceolate, opposite, decussate, petiolate, subacute, margin sinuate. First pr.

1·1 × 0·5, petiole 0·5; second 2 × 0·6, petiole 0·5 cm. First internode 1·2, second 2·4, third 1·6 cm. Stem and leaves covered with stellate hairs. The seedling of *E. eugenioides* is very distinct from those of the others of the group.

E. Muelleriana A. W. Howitt (Pl. li., fig.5).—Hypocotyl terete, covered with stellate hairs, 0·6 cm. Cotyledons reniform, entire, larger than those of *E. lævopinea*, glabrous, 0·9 × 0·8, petiole 0·3 cm. Leaves opposite, entire, broadly lanceolate, decussate, obtuse, shortly petiolate. Margin not sinuate as in *E. lævopinea*. First pr. 1·3 × 0·8, petiole 0·3; second 2 × 1, petiole 0·25; third 2·6 × 1·2, petiole 0·2 cm. First internode 0·3, second 0·4, third 0·6, fourth 0·7 cm. Internodes much shorter than in *E. lævopinea*. Stem and under surface of midrib covered with fine, glandular, reddish hairs. Upper surface of leaves smooth and shining. This confirms the observation of A. W. Howitt as to the smooth, shining character of the juvenile foliage. Study of the seedlings confirms the specific nature of *E. Muelleriana* as distinct from *E. pilularis*. They have nothing in common, except a superficial resemblance of the fruits. The cotyledons and primary leaves are distinct, and they should never be placed together.

E. obliqua L'Hér., Hobart, Tas. (Pl. lxiii., fig.3).—Cotyledons orbicular-reniform, entire, reddish on under surface, 0·4 × 0·35, petiole 0·3 cm. Leaves opposite, shortly petiolate, decussate, lanceolate, obtuse, lateral venation oblique, margin slightly sinuate. First pr. 1·8 × 0·7, petiole 0·3; second 2·8 × 1, petiole 0·2; third 3 × 1, petiole 0·2 cm. First internode 0·6, second 2·5, third 3·5 cm. Stem reddish. Stem and leaves covered with stellate hairs, but these shorter than in *E. lævopinea*.

E. obliqua, Mt. Gambier, S.A. (Pl. lxiv., fig.1).—In this form, the cotyledon-leaves are larger than in the Tasmanian, and the primary leaves broader and more ovate.

E. Marsdeni, sp.nov.; Toongabbie, N.S.W. (Pl. lxvii., fig.4).—Hypocotyl terete, glabrous, reddish, 0·4 cm. long. Cotyledons the smallest seen in the Stringybarks, 0·25 × 0·2, petiole 0·2 cm., orbicular-reniform, entire, purplish on under surface, glabrous. Leaves opposite, decussate, obtuse, shortly petiolate, lanceolate,

venation pinnate, rather oblique, edges sinuate. First pr. 0·8 × 0·3, petiole 0·25; second 1·5 × 0·6, petiole 0·3; third 3·6 × 0·8, petiole 0·3 cm. First internode 0·3, second 0·4, third 0·9, fourth 2 cm. Stem reddish, and both it and leaves covered with fine stellate hairs. This seedling has some resemblance to those of *E. Moorei* (Maiden), and *E. eugenioides*.

E. regnans F.v.M. (Pl. lxvi., fig.1).—Cotyledons reniform, entire, 0·6 × 0·45, petiole 0·3 cm. Leaves opposite, ovate-lanceolate, with sinuate and slightly serrate margins, petiolate, venation somewhat oblique, intramarginal vein close to edge, upper surface smooth and shining; lower surface with a few stellate hairs; oil-dots few in number. First pr. 2·5 × 1, petiole 0·3; second 3·3 × 1·5, petiole 0·3 cm. First internode 0·5, second 0·8 cm. Stem and leaves covered with short, glandular hairs. Although this species has a smooth bark, the seedling is so much of the type of the Stringybarks, that I have placed it with them. The reniform anthers, it possesses, also support this grouping.

E. fastigata Deane & Maiden (Pl. lviii., fig. 5).—Cotyledons small, reniform or triangular, petiolate. Leaves opposite, but soon alternate, entire, shortly petiolate, then petioles longer, lanceolate, acute, oil-dots fairly numerous. Venation oblique; intramarginal vein away from edge and looped with lateral veins. Leaves and stem covered with fine hairs, but soon becoming smooth. This seedling is quite distinct from that of *E. regnans*, having smaller cotyledons, much narrower lanceolate leaves of fine texture, and fairly plentiful oil-glands, so agreeing with the results of the distillation of the oils.

i.(*c*). Cotyledons small, entire, reniform or orbicular. Leaves mostly glabrous and petiolate.

E. Dawsoni R. T. Baker (Pl. lviii., fig.4).—Cotyledons reniform, glabrous, 0·4 × 0·3, petiole 0·3 cm. Leaves entire, opposite, decussate, glabrous, petiolate, lanceolate, acute. I was able to raise only one seedling of this species, but, by comparison, a great difference will be seen between it and those of *E. ovalifolia* and *E. polyanthema*.

E. dumosa A. Cunn.(Pl. liii., fig.2; Pl. lxix., fig.5).—Cotyledons reniform-orbicular, glabrous, 0·25 × 0·2, petiole 0·3 cm. Leaves

opposite, petiolate, lanceolate, glabrous, obtuse. First pr. linear-lanceolate; second 1 × 0·4, petiole 0·6; third 1·8 × 0·6, petiole 0·6 cm First internode 0·6, second 1·2, third 1·3 cm. The cotyledons are worthy of note, as they differ so greatly from those of the rest of the Mallees, especially those of the *E. gracilis* type.

E. populifolia Hook. (Pl. xlvii., fig.2).—Cotyledons very small, obtusely quadrilateral or orbicular, entire, glabrous, petiolate, 0·15 × 0·1, petiole 0·15 cm. Leaves opposite, entire, petiolate, glabrous, lanceolate, subacute. First pr. 0·9 × 0·3, petiole 0·4; second 1·2 × 0·5, petiole 0·5; third 1·6 × 0·6, petiole 0·3 cm. First internode 0·4, second 0·3, third 0·4 cm

E. quadrangulata Deane & Maiden (Pl. xliv., fig.7).—Cotyledons orbicular-reniform, reddish on under surface, 0·25 × 0·2, petiole 0·15 cm. Leaves narrow-lanceolate, glabrous, opposite, subacute, sessile, reddish on under surface.

E. incrassata Labill. (Pl. lxvi., fig.3).—Cotyledons reniform, entire, glabrous, purplish-red beneath, 0·6 × 0·5, petiole 0·5 cm. Leaves opposite, decussate, entire, glabrous, obtuse, petiolate.

E. Moorei Maiden & Cambage (Pl. lxvi., fig.2).—Cotyledons small, orbicular-reniform, glabrous, purplish on under surface, 0·2 × 0·15, petiole 0·15 cm. Leaves opposite, decussate, sessile, lanceolate, obtuse, glabrous, entire, dark green. First pr. 1 × 0·5, second 2·5 × 0·7, third 3 × 0·8 cm. First internode 0·2, second 0·4, third 1, fourth 1·8 cm. Stem purplish-red, covered with short, stellate hairs, terete. This species has been said to be closely related to *E. stellulata*, but the seedlings are very different, both as to cotyledons and primary leaves; these latter, in *E. stellulata*, being ovate or almost orbicular.

ii. Eucalypts with emarginate cotyledons.

(*a*). Cotyledons large, slightly emarginate, cuneate at base, petioles long.

E. marginata Sm.—Described in Lubbock's "On Seedlings." Mr. Maiden's figure, Plate xl., "Critical Revision of Eucalyptus," and description are really of *E. calophylla*. This error was corrected later. The cotyledons are much more asymmetrical than shown by Lubbock (Pl. lxix., fig.6).

E. Todtiana F.v.M.(Pl.xli., fig.1).—Hypocotyl terete, glabrous, reddish, 1·3 cm. long. Cotyledons somewhat like those of *E. marginata* but more symmetrical, obtusely quadrilateral, slightly emarginate, cuneate at base, 1·8 × 1·2, petiole 0·9 cm. Petiole terete, glabrous, reddish, grooved on upper side at distal extremity. Leaves opposite, decussate, broadly lanceolate, tapering at base, coriaceous, obtuse, sessile, dark green, glabrous, lateral veins oblique, parallel. Stem terete, reddish, with a few glandular hairs. First pr. of leaves 3·6 × 1·6; second 4 × 1·6 cm. First internode 0·6, second 0·6, third 0·5 cm.

E. megacarpa F.v.M. (Pl. lii., fig.3) —Hypocotyl short, terete, reddish, glabrous, 0·6 cm. long. Cotyledons resemble those of *E. Todtiana*, but broader, and petiole shorter and narrower. They are obtusely oblong, trinerved, 1·5 × 1, petiole 0·7 cm., base of lamina cuneate. Leaves entire, opposite, decussate, obtuse, sessile, glabrous, broadly lanceolate, venation pinnate, open, intramarginal vein ill defined. First pr. 4 × 1·5, second 4·5 × 1·8 cm. First internode 0·7, second 2·5, third 2 cm. Stem terete, reddish, glabrous.

E. santalifolia F.v.M.(Pl.l., fig.5) —Hypocotyl terete, glabrous, 0·7 cm. long. Cotyledons smaller than in *E. megacarpa* but of same form, obtusely quadrilateral, cuneate at base, slightly emarginate, 1 × 0·7, petiole 0·5 cm. Leaves opposite, decussate, glabrous, sessile, ovate, obtuse, cordate at base, lateral veins parallel, somewhat oblique. First pr. 2·4 × 1·1, second 3 × 1·4, third 3·1 × 1·6 cm. First internode 0·4, second 0·2, third 0·6, fourth 1·2 cm. Stem reddish, terete, glabrous.

The above four species form a good group, as far as the seedlings are concerned, *E. marginata* being most removed from the others in its asymmetrical cotyledons, long petioles, and subterranean hypocotyl. They all have broad, sessile leaves, which are large from the very first pair.

ii.(*b*). Eucalypts with cotyledons large then smaller, usually obtusely quadrilateral, slightly emarginate, leaves usually sessile. Undersurface of cotyledons and leaves generally tinged deep purplish colour. This group comprises the "Peppermints" and their near allies containing phellandrene, eucalyptol, and pinene.

It is confined to South-eastern Australia and Tasmania. In nearly all cases, the anthers are kidney-shaped.

E. Planchoniana F.v.M.(Pl. lix., fig.3; Pl. lxix., figs.7 and D).—Hypocotyl erect, terete, glabrous, reddish, 1 cm. long. Cotyledons emarginate, under side reddish, glabrous, obcordate, cuneate at base, 1·1 × 0·9, petiole 0·5 cm. Leaves opposite, decussate, lanceolate, subacute, glabrous, tapering at both ends, sessile, edges waved First pr. 3·6 × 1, second 4 × 1 cm. First internode 1·3, second 1·2 cm. Stem reddish, terete, glabrous. The cotyledons in this species are the largest in the group, but the seedling has much resemblance to that of *E. pilularis* in other respects. Its oil, also, is of the same class. This species has parallel anthers, however.

E. pilularis Sm.(Pl. lix., fig.2).—Cotyledons reniform, glabrous, deep purple beneath, 0·6 × 0·3, petiole 0·3 cm. Leaves opposite, lanceolate, subacute, sessile, tapering at both ends, becoming cordate with rounded auricles at base, glabrous, margin waved, purplish-tinged on under sides. First pr. 2·4 × 0·7, second 3·6 × 1·4, third 6 × 1·6 cm. First internode 0·9, second 1·2, third 2·4, fourth 2 cm. Stem terete, glabrous, purplish. This seedling bears no resemblance whatever to that of *E. Muelleriana.*

E. acmenioides Schau.(Pl. lvii., fig.1; Pl. lxix., fig.8).—Cotyledons obtusely quadrilateral, slightly emarginate, slight tinge of reddish-purple beneath, 0·6 × 0·5, petiole 0·3 cm. Leaves lanceolate, opposite, sessile, obtuse then subacute, tapering at base, then cordate and stem-clasping, glabrous, entire. First pr. 1·8 × 0·6, second 2·2 × 0·7, third 3 × 0·8 cm. First internode 1·6, second 1·8, third 1·8 cm. Stem terete, glabrous.

E. umbra R. T. Baker (Pl. xli., figs.3-4).—Cotyledons resemble those of *E acmenioides*, but are a little smaller. The first pair of leaves generally shortly petiolate, the next and following being sessile and cordate at base and ovate-lanceolate, broader than in *E. acmenioides*, the venation also being pinnate, parallel, and less oblique.

E. carnea R. T. Baker (Pl. lvii., fig.2).—This seedling closely resembles *E. umbra*, but the cotyledons are smaller, and the emargination very slight. The first pair of leaves has petioles

0·3 cm. long, the second pair subsessile, and the following leaves closely resembling those of *E. umbra*.

E. Risdoni Hook. f.(Pl. lx., fig. 1).—Cotyledons obtusely quadrilateral, slightly emarginate, cuneate at base, 0·4 × 0·35, petiole 0·3 cm. Leaves opposite, decussate, sessile, obtuse, ovate, then triangular with cordate base, glabrous, entire. First pr. 1·8 × 0·9, second 2·5 × 1·8, third 2 × 1·2 cm. Leaves and cotyledons purplish beneath. First internode 1, second 1·2, third 1·3 cm. Stem terete, glabrous, purplish. This seedling is strikingly dissimilar to that of *E. amygdalina*, with which it was synonymised by Mueller. The primary broad ovate then triangular leaves are entirely different from those of *E. amygdalina*.

E. linearis A. Cunn.(Pl. lx., fig. 5).—Cotyledons triangular, slightly emarginate, cuneate at base, 0·45 × 0·45, petiole 0·4 cm. long, deep purple on under side. Leaves opposite, decussate, subsessile, lanceolate, obtuse. First pr. 1·5 × 0·45, second 2·5 × 0·6, third 2·6 × 0·5 cm. First internode 0·5, second 1, third 1·2 cm. Stem and under sides of leaves are purplish. The cotyledons of this species are quite distinct from those of *E. amygdalina* (Tasmanian form), being larger and triangular, and the emargination more distinct. The primary leaves of both are much alike.

E. phlebophylla F.v.M. (Pl. lxiv., fig. 3).—Cotyledons obtusely quadrilateral, slightly emarginate, 0·6 × 0·5, petiole 0·4 cm. Leaves opposite, lanceolate, subacute, shortly petiolate for three pairs, then sessile, lateral veins oblique, glabrous. First pr. 1·1 × 0·4, sessile; second pr. 1·3 × 0·5, petiole 0·3; third 1·8 × 0·8, petiole 0·25; fourth 2·5 × 1·1 cm., sessile. First internode, 0·5, second 0·4, third 0·4, fourth 0·6 cm. Stem terete, glabrous, reddish.

This species has been synonymised with *E. coriacea*, but the seedlings are very distinct, the former having larger cotyledons, and the primary leaves lanceolate instead of oval. The internodes are also shorter, the leaves being thus more crowded. I must, therefore, disagree with the placing of them under the one species by Mueller and Maiden.

E. hæmastoma Sm.(Pl. lvii., fig. 3).—Cotyledons obtusely quadrilateral, slightly emarginate, glabrous, deep purple beneath, 0·5 × 0·3, petiole 0·5 cm. long. Leaves lanceolate, tapering at

base, opposite, decussate, obtuse, petiolate then sessile, glabrous, purplish on under sides. First pr. 2·5 × 0·7, petiole 0·5; second 5 × 2, subsessile; third 5 × 2 cm., sessile. Lateral veins parallel, oblique. First internode 0·6, second 1, third 3 cm. Stem terete, glabrous.

E. stricta Sieb. (Pl. liv., fig.5). —Cotyledons almost orbicular, emargination slight or none, 0·5 × 0·4, petiole 0·4 cm., deep purple beneath. Leaves opposite, lanceolate, obtuse, entire, glabrous, shortly petiolate then subsessile, purplish beneath, venation oblique, pinnate. First pr. 2·2 × 0·9, petiole 0·3; second 3·3 × 1·1, petiole 2 cm. First internode 0·6, second 1, third 0·8 cm.

E. Rossii R. T. Baker and H. G. Smith (Pl. xlviii., fig.6).— Cotyledons closely resembling those of *E. stricta*, and are slightly emarginate, and broader than in that species. Leaves lanceolate and petiolate, then oval or ovate and subsessile, obtuse, opposite, entire, glabrous, venation somewhat oblique, tinged red on under sides. First pr. 1·5 × 0·6, petiole 0·3; second 2·4 × 1·2 cm., subsessile. First internode 0·6, second 1·1, third 1·1 cm.

Messrs. Baker and Smith class *E. Rossii* with the eucalyptol-pinene group, and *E. stricta* with the eucalyptol-pinene-aroma-dendral group, the members of which, as a rule, have parallel anthers, while these have reniform anthers. The seedlings explain the seeming anomaly, as these species are now shown to have great affinity to the "Peppermint" group, and, apart from their chemical composition, should be placed therein.

E. striaticalyx (Pl. lv., fig.3).—Hypocotyl terete, glabrous, reddish, 1·5 cm. long. Cotyledons obtusely quadrilateral, glabrous, purplish on under sides, 0·6 × 0·5, petiole 0·5 cm. Leaves entire, glabrous, opposite, obtuse, petiolate, ovate-lanceolate or ovate. First pr. 1·2 × 0·5, petiole 0·6; second 2 × 1, petiole 0·6 cm. First internode 0·6, second 0·9, third 1·7 cm. Stem terete, glabrous. Though the cotyledons are of the same form, the leaves are different from those of the others of the group.

E. piperita Sm. (Pl. lx., fig.3; Pl. lxix., fig.9).—Cotyledons obtusely oblong, slightly emarginate, purplish on under sides, 0·6 × 0·5, petiole 0·2 cm. Leaves opposite, ovate-lanceolate, obtuse, petiolate then sessile, glabrous, entire. First pr. 1·3 × 0·6, petiole

0·3; second 2·5 × 1, subsessile; third 3·3 × 1 cm., sessile. Leaves have slight reddish tinge underneath. First internode 1, second 0·6, third 1·3, fourth 2·5 cm.

E. amygdalina Labill.—Before seeing the remarks of Messrs. Baker & Smith, in their "Eucalypts of Tasmania," on this species, I had been puzzled by the marked difference between the seedlings of the Tasmanian *E. amygdalina* and those of the mainland. This was explained in the light of the knowledge of the oils and morphology of the two.

E. amygdalina (Hobart, Tas.) (Pl. lxi., fig.4; Pl. lxii, fig.2).—Cotyledons small, obtusely quadrilateral. emargination slight or absent, 0·3 × 0·25, petiole 0·3 cm. Leaves opposite, as far as seen, narrow-lanceolate, tapering at both ends, subacute, sessile or subsessile, edges sometimes waved, a few stellate hairs on midrib. First pr. 0·8 × 0·25, second 1·1 × 0·3, third 1·3 × 0·3, fourth 1·8 × 0·3 cm. First internode 0·3, second 0·6, third 0·8, fourth 1 cm. Stem purplish, terete, covered with glandular hairs.

E. amygdalina (Yarra Junction, Vic.) (Pl. lxii., fig.1; Pl. lxix., fig.11).—In this, the cotyledons are larger, the emargination more pronounced, and the leaves opposite but much broader, ovate-lanceolate, obtuse, cordate at base, glabrous. The stem is also glabrous. In *E. amygdalina* from Laurel Hill, N.S.W., the primary leaves are of the same character, but not so broad.

E. coccifera Hook. f. (Pl. lx., fig.2).—The seedlings of this species are very characteristic, and the dried specimen makes a beautiful object when mounted. Cotyledons obtusely quadrilateral, cuneate at base, slightly emarginate, 0·5 × 0·4, petiole 0·3 cm. Leaves entire, opposite, glabrous, oval, obtuse, sessile, petioles at first scabrous. First pr. 1 × 0·7, second 1·4 × 1, third 2·1 × 1·2 cm. Stem terete, scabrous; stem and under sides of cotyledons and leaves deep purplish-red.

E. Luehmanniana F.v.M. (Pl. lxii., fig. 3; Pl. lxix., fig. 10).—Cotyledons obtusely quadrilateral, slightly emarginate, cuneate at base, 0·6 × 0·5, petiole 0·5 cm. Leaves opposite, entire, glabrous, broadly lanceolate, tapering at base, obtuse, venation fairly oblique, intramarginal vein away from edge, and showing the characteristic looping arrangement, such as is met with in

this group. First pr. 1·8 × 0·8, petiole 0·4; second 2·5 × 1·1, petiole 0·3; third 3·6 × 2, petiole 0·4 cm. Stem terete, glabrous. Stem and undersides of leaves and cotyledons deep purple.

E. oreades R. T. Baker (Pl. xlii., fig.4).—The cotyledons are almost identical with those of *E. Luehmanniana.* The leaves are similar, but are larger, broader, and more ovate than in that species. In both, the leaves are shortly petiolate.

E. Sieberiana F.v.M. (Pl. lxii., fig.5).—The cotyledons are also very like those of *E. Luehmanniana.* The leaves are ovate-lanceolate, obtuse, opposite, large, first pair shortly petiolate then sessile, tapering to base. Venation as in *E. Luehmanniana.*

The above three species resemble one another closely, and are hard to distinguish. *E. Luehmanniana* has smaller petiolate leaves. In *E. oreades*, the leaves are very large and petiolate; in *E. Sieberiana*, the leaves, from the second pair, are sessile.

E. Delegatensis R. T. Baker (Pl. lxiii., fig.2).—Cotyledons resemble those of *E. Luehmanniana*, but are smaller, not so cuneate at base, emargination practically absent. Leaves of same type as in *E. oreades* and petiolate.

E. campanulata R. T. Baker (Pl. lx., fig.6).—Cotyledons obtusely quadrilateral, slightly emarginate, 0·45 × 0·4, petiole 0·25 cm. Leaves opposite, ovate, obtuse, petiolate, glabrous. Stem and under sides of leaves and cotyledons deep purplish-red.

E. Andrewsi Maiden (Pl. lxiv., fig.2).—Cotyledons resemble those of *E. campanulata.* Leaves opposite, entire, glabrous, petiolate, broadly lanceolate, obtuse, not so deeply coloured beneath as in *E. campanulata.* Messrs. Baker & Smith (Journ. Proc. Roy. Soc. N. S. Wales, Vol. xlv.) consider this a northern form of *E. dives* inasmuch as the fruits, oils, timber, and bark are identical. "It seems now that the only difference, so far, is that no sessile cordate sucker-leaves have been found in connection with *E. Andrewsi.* Mr. Cambage informs us that the seedlings of these two trees are different." My results confirm Mr. Cambage's view. The cotyledons of *E. Andrewsi* are much larger than those of *E. dives*, and the leaves are broadly lanceolate and petiolate, while those of the latter are sessile, ovate and cordate.

E. tæniola Baker & Smith (Pl. lxviii., fig.2).—Cotyledons obtusely quadrilateral, slightly emarginate, 0·45 × 0·4, petiole 0·3 cm. Leaves opposite, entire, lanceolate, obtuse, then narrowly lanceolate and acute, subsessile, then sessile, lateral veins oblique and looped with the intramarginal vein, which is away from the edge. Stem and under surface of leaves and cotyledons purplish-red. This seedling is very like that of *E. amygdalina*, but quite different from that of *E. virgata*, with its broad, primary leaves.

E. coriacea A. Cunn. (Pl. lxiii., fig.1).—Cotyledons smaller than in most of its congeners, obtusely quadrilateral, not stained on under sides, emargination almost absent, 0·4 × 0·3, petiole 0·3 cm. Leaves opposite, entire, glabrous, ovate or oval, obtuse, shortly petiolate, lateral veins oblique, looped. First pr. 1·2 × 0·7, petiole 0·3; second 2·5 × 1·4, petiole 0·3; third 2·8 × 1·5, petiole 0·2 cm. First internode 0·9, second 1·5, third 1·6 cm. Leaves paler than usual in this class, stem glabrous, green. I would again draw attention to the distinct differences in the seedlings of this and *E. phlebophylla*.

E. dives Schau. (Pl. lxiii., fig.4).—Cotyledons small but obtusely quadrilateral, not coloured on under sides, emargination very slight, lamina 0·3 × 0·25, petiole 0·25 cm. Leaves opposite, entire, ovate, obtuse, sessile, glabrous, venation well marked, lateral veins oblique and looped, intramarginal veins away from edge. First pr. 1·1 × 0·5, subsessile; second 2 × 0·9; third 2·5 × 1·2 cm. Stem terete, glabrous, reddish. First internode 0·7, second 1·1, third 2, fourth 2 cm.

E. radiata Sieb. (Pl. lxiv., fig.4).—Cotyledons obtusely oblong, slightly emarginate, 0·4 × 0·2, petiole 0·2 cm. Leaves opposite, lanceolate then ovate, subsessile then sessile, obtuse, glabrous, venation oblique, intramarginal vein looped and away from edge. Under surfaces of leaves and cotyledons not stained. First pr. 1 × 0·3, petiole 0·2; second 1·6 × 0·5, third 1·8 × 0·7 cm. Stem terete, glabrous, greenish. From what I have seen of the seedlings, I quite agree with those who separate *E. radiata* from *E. amygdalina*. In the former, we have more oblong, narrower cotyledons, and the first leaves are more ovate and shorter, also subsessile for the first few pairs.

E. apiculata Baker & Smith (Pl. lxv., fig.2).—Cotyledons obtusely quadrilateral, slightly emarginate, purplish-red underneath, lamina 0·5 × 0·4, petiole 0·4 cm. Leaves opposite, entire, glabrous, lanceolate, subacute, tapering at base, shortly petiolate. First pr. 1·8 × 0·5, second 2·5 × 0·7 cm. First internode 0·7, second 0·6 cm.

This species has been confused with *E. stricta*, but although the cotyledons are almost identical, the primary leaves differ, those of *E. apiculata* being narrower and more pointed, also tapering at base. This, then, confirms the analysis of the oils. Attention must also be drawn to the difference in the anthers, *E. apiculata* in this respect varying from the rule in this group.

E. virgata Sieb.,(St. Mary's, Tas.) [Pl. lxv., fig.3].—Hypocotyl short, 0·5 cm. Cotyledons obtusely quadrilateral, emargination almost absent, lamina 0·45 × 0·4, petiole 0·4 cm. Leaves opposite, sessile, ovate-lanceolate, obtuse, entire, glabrous, lateral veins oblique and forming a looped arrangement with the intramarginal vein, which is removed from the edge. First 1·1 × 0·5 cm., shortly petiolate; second 2 1 × 0·9, third 3·6 × 1·2 cm. First internode 0·4, second 0·3, third 0·9, fourth 1·5 cm. The first internodes are very short, and, consequently, the leaves are crowded together. Cotyledons and first leaves are stained a deep blackish-purple.

Much controversy has occurred over this species, and as to whether it is identical with *E. Sieberiana* or not. The seedlings, however, are very distinct, the cotyledons of *E. virgata* being smaller and different in shape, and the leaves smaller, narrower, and more obtuse.

E. obtusiflora DC. (Pl. lxv., fig.5).—Cotyledons resemble those of *E. Sieberiana*, but are slightly smaller. Leaves opposite, entire, glabrous, lanceolate, obtuse, tapering into a short petiole. First pr. 2·8 × 0·8, second 3·8 × 1·1 cm. Lateral veins oblique, looped. First internode 1·2, second 1·2 cm. Cotyledons and leaves only slightly stained purplish-red on under sides.

E. stellulata Sieb. (Pl. lxiv., fig.7).—Cotyledons obtusely quadrilateral, very slightly emarginate, 0·2 × 0·15, petiole 0·15 cm. Leaves opposite, entire, glabrous, ovate, obtuse, shortly petiolate, then sessile, glaucous, lateral veins oblique, looped with intramarginal vein.

ii.(c^1). Eucalypts with cotyledons obtusely oblong, slightly emarginate; sometimes slightly lobed.

This and the next two groups are the most difficult to differentiate. It is at most a tentative classification, but was done in default of any other. The forms and relations of the Eucalypts with small cotyledons are many, and they merge so into one another, that it is quite possible, in the light of further knowledge, these groups will have to be altogether recast. They comprise the "Ironbarks" and "Boxes" with anthers opening in pores, also most of the "Parallelantheræ" whose anthers are parallel. Most of the eucalyptol-pinene species come in these groups, also many of those containing aromadendral. A few of the eucalyptol-pinene-phellandrene species are also included, but the piperitone-phellandrene and piperitone-phellandrene-eucalyptol oils are not represented. I have kept the "Ironbarks" together, for purposes of comparison.

E. botryoides Sm.(Pl. xlii., fig. 2).—Cotyledons obtusely oblong, emarginate, 0·55 × 0·2, petiole 0·4 cm. Leaves opposite for first three pairs, then alternate, entire, glabrous, lanceolate, obtuse, petiolate, venation somewhat oblique, drying pale green. First pr. 1·1 × 0·5, petiole 0·3; second 2·5 × 0·7, petiole 0·5; third 3·5 × 1, petiole 0·5 cm. Stem terete, glabrous. First internode 0·6, second 0·6, third 1·5 cm.

E. saligna Sm. (Pl. xlii., fig. 3).—Cotyledons smaller and lobes at a more acute angle than in *E. botryoides*, hence the emargination is deeper, lamina 0·45 × 0·18, petiole 0·3 cm. Leaves opposite, tending soon to alternate, glabrous, petiolate, lanceolate, obtuse, venation obscure, leaves dark green. First pr. 0·6 × 0·2, petiole 0·3; second 1·5 × 0·3, petiole 0·5; third 1·8 × 0·6, petiole 0·5 cm. Stem terete, glabrous. First internode 0·6, second 1·2, third 1, fourth 1·2 cm.

E. robusta Sm. (Pl. xlii., fig 4).—Cotyledons of same form but smaller than in *E. saligna*, lamina 0·3 × 0·15, petiole 0·2 cm. Leaves opposite, entire, glabrous, dark green, obtuse, lanceolate, petiolate, venation obscure, somewhat oblique. First pr. 1 × 0·15, petiole 0·3; second 1·2 × 0·4, petiole 0·5; third 2·5 × 0·9, petiole 0·6; fourth 3·3 × 1·2, petiole 0·6 cm. Stem terete, glabrous. First internode 0·7, second 0·8, third 1·2, fourth 1·5 cm.

The above three species chemically belong to the pinene group, in which *E. corymbosa* and the other "Bloodwoods" are placed. But, botanically, they have always been considered a great deal removed from the Bloodwoods. The seedlings bear this out. As the fruits should indicate beforehand, the cotyledons are small and emarginate, and the leaves are petiolate and glabrous. Stem glabrous.

E. diversicolor F.v M. (Pl. xlii., fig.6).—Cotyledons obtusely oblong, emargination almost or quite absent, lamina 0·45 × 0·3, petiole 0·3 cm. Leaves lanceolate then ovate, petiolate for first two pairs then sessile, pale, obtuse, opposite, entire, glabrous. First pr. 0·8 × 0·25, petiole 0·2; second 1·2 × 0·5, petiole 0·15; third 2·5 × 0·8; fourth 2·2 × 1·5 cm. First internode 0·9, second 1·1, third 1·1, fourth 1 cm. Stem glabrous, terete.

E. Baeuerleni F.v.M. (Pl. xliii., fig.6).—Cotyledons obtusely quadrilateral, slightly emarginate, asymmetrical, lamina 0·6 × 0·3, petiole 0·3 cm. Leaves petiolate, then sessile from the third pair, opposite, subacute, glabrous. First pr. 0·8 × 0·15, petiole 0·2 cm; second 1·2 × 0·3, petiole 0·15; third 1·4 × 0·5 cm. First internode 0·6, second 0·7, third 0·6 cm. Stem terete, glabrous.

E. propinqua Deane & Maiden (Pl. xliii., fig.4). – Cotyledons slightly emarginate, 0·4 × 0·2, petiole 0·3 cm. Leaves opposite, entire, glabrous, lanceolate, subacute, petiolate. First pr. 0·9 × 0·25, petiole 0·2; second 1·2 × 0·3, petiole 0·4; third 1·4 × 0·3, petiole 0·5 cm. First internode 1, second 0·6, third 0·6, fourth 0·6 cm. Stem terete, glabrous.

E. microcorys F.v.M. (Pl. xliii., fig.3; Pl. lxix., fig.12).—Cotyledons 0·5 × 0·3, petiole 0·25 cm., slightly emarginate. Leaves opposite, entire, glabrous, lanceolate, acute. First pr. 0·8 × 0·3, petiole 0·3; second 1 × 0·5, petiole 0·6; third 1·4 × 0·6, petiole 0·7 cm. First internode 1, second 0·8, third 1·1 cm. Stem terete, glabrous.

In some respects, this might be put among the "Peppermints," but, on the whole, I prefer it here. One should note, however, that the anthers are reniform.

E. paniculata Sm. (Pl. xliv., fig.2).—Cotyledons small, obtusely oblong, slightly emarginate, 0·3 × 0·15, petiole 0·2 cm. Leaves

opposite, entire, glabrous, lanceolate, then ovate, obtuse, petiolate, venation parallel, oblique. First pair of leaves 1 × 0·25, petiole 0·3; second 1·8 × 0·8, petiole 0·5; third 2·8 × 1·4, petiole 0·5 cm. First internode 0·7, second 0·6, third 1·2, fourth 2·2 cm. Stem terete, glabrous.

E. crebra F.v M. (Pl. lxi., fig.1). Cotyledons like those of *E. paniculata* and emarginate. Leaves opposite but soon alternate, lanceolate, petiolate, subacute then obtuse, glabrous. First pr. 1 × 0·15, petiole 0·4; second 1·8 × 0·6, petiole 0·6; third 3·2 × 0·9, petiole 0·6 cm. First internode 0·7, second 1·4, third 2·5 cm. Stem terete, glabrous.

E. siderophloia Benth. (Pl. lxi., fig.3) —Cotyledons larger than in the other "Ironbarks," 0·6 × 0·3, petiole 0·2 cm., emarginate. Leaves opposite, entire, glabrous, lanceolate then ovate, obtuse, petiolate, venation oblique. First pr. 1 × 0·3, petiole 0·3; second 1·7 × 1, petiole 0·4; third 3·6 × 1·7, petiole 0·4 cm. First internode 1, second 1, third 1·4, fourth 1·8 cm. Stem terete, glabrous.

E. melanophloia F.v.M. (Pl. lxi., fig.2).—Cotyledons 0·5 × 0·3, petiole 0·25, slightly emarginate, asymmetrical. Leaves lanceolate, obtuse, opposite, entire, glabrous, shortly petiolate. First pr. 1 × 0·3, petiole 0·15; second 1·5 × 0·45, petiole 0·25; third 1·8 × 0·55, petiole 0·3 cm. First internode 1, second 1, third 1·4, fourth 1·8 cm. Stem terete, glabrous.

E. sideroxylon A. Cunn. (Pl. xlviii., fig.5).— Cotyledons 0·4 × 0·25, petiole 0·25 cm., slightly emarginate. Leaves lanceolate, then ovate-lanceolate, obtuse, glabrous, entire, petiolate. First pr. 0·8 × 0·3, petiole 0·2; second 1·3 × 0·6, petiole 0·5; third 1·9 × 1, petiole 0·5 cm. First internode 0·8, second 0·6, third 1·2 cm. Stem terete, glabrous. The seedlings of the "Ironbarks" bear a general family resemblance to one another. The cotyledons are all fairly small and oblong, and slightly emarginate. The leaves are petiolate, those of *E. melanophloia* having the shortest petioles; those of *E. crebra* and *E. sideroxylon* are lanceolate, while those of *E. siderophloia* and *E. paniculata* are ovate.

E. hemiphloia F.v.M. (Pl. lvi., fig.5).—Cotyledons obreniform, petiolate, slightly emarginate, 0·5 × 0·3, petiole 0·4 cm. Leaves lanceolate then ovate, subacute, entire, opposite, glabrous. First

pr. 1·2 × 0·3, petiole 0·4; second 1·9 × 0·6, petiole 0·3; third 3 × 0·9, petiole 0·5 cm. First internode 1·2, second 1·2, third 1·8, fourth 2 cm. Stem terete, glabrous.

E. albens Miq.(Pl. lvi., fig.4).—Cotyledons slightly smaller than in *E. hemiphloia*, slightly emarginate. Leaves entire, opposite, glabrous, lanceolate then ovate, petiolate, obtuse. First pair 1 × 0·3, petiole 0·3; second 1·8 × 0·9, petiole 0·5; third 2 × 1·1, petiole 0·5 cm. First internode 0·7, second 0·9, third 1 cm. Stem terete, glabrous. These two "Boxes" may be distinguished by the larger cotyledons of *E. hemiphloia*, and its leaves are narrower than those of *E. albens*.

E. fasciculosa F.v.M. (Pl. li., fig. 3).—Cotyledons obtusely oblong, slightly emarginate, 0·5 × 0·3, petiole 0·3 cm. Leaves opposite, entire, then margins slightly serrate, lanceolate, subacute, glabrous, petiolate then subpetiolate, lateral veins oblique, parallel. First pr. 0·9 × 0·25, petiole 0·3; second 1·2 × 0·5, petiole 0·3; third 1·8 × 0·7; fourth 2·7 × 1 cm. First internode 0·6, second 0·9, third 0·9, fourth 1·1 cm.

E. Muelleri T. B. Moore (Pl. li., fig.5).—Cotyledons resemble those of *E. fasciculosa*. Leaves entire, opposite, glabrous, lanceolate, obtuse, shortly petiolate. Leaves and cotyledons deep purplish-red on under sides.

E. resinifera Sm. (Pl. xlv., fig.3; Pl. lxix., fig.13).—Cotyledons obreniform, emarginate, 0·45 × 0·25, petiole 0·25 cm. Leaves opposite, entire, obtuse, lanceolate, glabrous, petiolate, light green. First pr. 1·1 × 0·25, petiole 0·5; second 2 × 0·5, petiole 0·5; third 3·6 × 0·7, petiole 0·5 cm. First internode 0·7, second 0·6, third 1, fourth 1·2 cm. Stem terete, glabrous.

E. punctata DC. (Pl. xlvi., fig.4).—Cotyledons resemble those of *E. resinifera*. Leaves entire, opposite, lanceolate, obtuse, petiolate, glabrous. First pr. 0·9 × 0·25, petiole 0·25; second 1·6 × 0·6, petiole 0·5; third 3 × 0·9, petiole 0·6 cm. First internode 0·7, second 0·6, third 1·2, fourth 0·8 cm. Stem terete, glabrous.

E. longifolia Link & Otto(Pl. xlvii., fig.4).—Cotyledons and leaves closely resemble those of *E. resinifera*, but, in the former, the leaves are more obtuse and the petioles longer.

E. saligna var. *pallidivalvis* R. T. Baker(Pl. lv., fig.8).—Cotyledons obreniform, emarginate, 0·5 × 0·25, petiole 0·3 cm. Leaves opposite, entire, lanceolate, obtuse, glabrous. First pr. 0·8 × 0·3, petiole 0·2; second 0·9 × 0·35, petiole 0·25; third 1·2 × 0·5, petiole 0·25 cm. First internode 0·6, second 0·6, third 0·3 cm. Stem terete, glabrous.

This seedling is quite distinct from that of *E. saligna*, the leaves being broader and shorter, and the internodes shorter. The cotyledons are alike, and this would account for the fruits being so much of the same form.

E. leucoxylon F.v.M.(Pl. lxvii., fig.5).—This seedling has been described by Lubbock, but seedlings grown from *E. leucoxylon*, Dimboola, Victoria, sent me by Mr. Baker, do not tally with Lubbock's description. In these, the cotyledons are transversely oblong, obtuse, petiolate, margin truncate or slightly emarginate, lamina 0·5 × 0·35, petiole 0·3 cm. Leaves entire, opposite, glabrous, slightly glaucous, ovate-lanceolate then ovate, cordate at base, obtuse, first two pairs subsessile, then sessile. First pr. 0·7 × 0·4, second 1·5 × 0·9, third 1·9 × 1·1 cm. First internode 1, second 1·3, third 2·5, fourth 3·5 cm. Stem terete, glabrous.

E. patentinervis R. T. Baker(Pl. lxiv., fig.6).—Cotyledons transversely oblong, obtuse, slightly emarginate, sometimes asymmetrical, 0·5 × 0·25, petiole 0·3 cm. Leaves entire, opposite, soon alternate, glabrous, lanceolate, subacute, petiolate. First pr. 1 × 0·3, petiole 0·3; second 1·3 × 0·45, petiole 0·3 cm. First internode 1·2, second 1·5, third 1·1 cm. Stem terete, glabrous.

E. sp. nov., R. T. Baker(Pl. l., fig.4).—Cotyledons resemble those of *E. leucoxylon*, but are purple underneath. Leaves opposite, soon alternate, lanceolate, obtuse, petiolate, edges serrate, veins oblique and parallel. First pr. 1·2 × 0·5, petiole 0·6; second 2·3 × 0·8, petiole 0·6; third 2·8 × 1·1, petiole 0·5 cm. First internode 1·2, second 1·3 cm. Stem slightly scabrous.

E. viminalis Labill. (Pl. lviii., fig.1).—Cotyledons transversely oblong, obtuse, truncate rarely, slightly emarginate, cordate at base, 0·5 × 0·25, petiole 0·25 cm. Leaves opposite, entire, glabrous, lanceolate then ovate-lanceolate, obtuse, sessile. First pr. 1 × 0·3, petiole 0·15; second 1·4 × 0·6; third 2·5 × 0·8; fourth 3 × 1·1 cm. First internode 1, second 1·2, third 1·5, fourth 1·5 cm. Stem terete, glabrous.

E. Smithii R. T. Baker (Pl. xlvii., fig.5).—Cotyledons transversely oblong, obtuse, emarginate, 0·6 × 0·25, petiole 0·4 cm. Leaves opposite, entire, glabrous, lanceolate then ovate-lanceolate, obtuse, sessile, cordate at base. First pr. 1·6 × 0·3, tapering at base; second 2·2 × 1·5, third 2·5 × 1·7 cm. First internode 0·7, second 1·2, third 2·4, fourth 3 cm. Stem terete, glabrous.

E. cinerea F.v.M. (Pl. xlvii., fig. 3).—Cotyledons transversely oblong, obtuse, slightly emarginate, 0·4 × 0·2, petiole 0·2 cm. Leaves opposite, entire, glabrous, glaucous, lanceolate and shortly petiolate for two pairs, then ovate, cordate, obtuse, venation oblique. First pair 0·7 × 0·2, second 1·5 × 0·6, third 1·8 × 1·1, fourth 1·9 × 1·3 cm. First internode 1, second 1·3, third 1·8, fourth 1·8 cm. Stem terete, glabrous.

E. Gunnii Hook.f.(Pl. lx., fig.4).—Cotyledons transversely oblong, obtuse, very slightly emarginate, 0·4 × 0·2, petiole 0·2 cm. Leaves opposite, entire, glabrous, glaucous, ovate or orbicular, obtuse, sessile, cordate. First pr. 0·4 × 0·2, second 0·6 × 0·3, third 0·8 × 0·5, fourth 1·2 × 0·8 cm. Stem terete, glabrous.

E. Perriniana F.v.M.(Pl. lii., fig.2).—Cotyledons as in *E. Gunnii*, but more cordate at base, very slightly emarginate. Leaves opposite, sessile, ovate, obtuse, cordate at base, stem-clasping then after 4-5 pairs perfoliate, glaucous. First pr. 1 × 0·4, second 1·7 × 1·1, third 1·5 × 1 cm. Stem terete, glabrous.

E. paludosa R. T. Baker (Pl. xliv., fig. 4).—Cotyledons transversely oblong, obtuse, slightly emarginate, 0·35 × 0·2, petiole 0·2 cm. Leaves opposite, entire, glabrous, lanceolate, petiolate then sessile.

E. lactea R. T. Baker(Pl. xliv., fig.5).—Cotyledons as in *E paludosa*. Leaves opposite, glabrous, entire, subsessile then sessile.

E. Stuartiana F.v.M.(Pl. xlix., fig.1; Pl. lxix., fig.14).—Cotyledons transversely oblong, obtuse, 0·45 × 0·15, petiole 0·2 cm. Leaves opposite, entire, glabrous, glaucous, ovate, cordate, obtuse. First pr. 0·9 × 0·3, petiole 0·15; second 1·5 × 0·9, third 1·5 × 1·1 cm. Stem terete, glabrous as far as grown. First internode 0·9, second 1, third 1, fourth 1 cm.

E. melliodora A. Cunn.(Pl. lvi., fig.1).—Cotyledons transversely oblong, obtuse, petiolate, slightly emarginate. Leaves alternate after first pair, glabrous, entire, lanceolate, obtuse then subacute, petiolate.

E. acervula Sieb.(Pl. lxvi., fig.4).—Cotyledons transversely quadrilateral, obtuse, slightly emarginate, 0·4 × 0·2, petiole 0·2 cm., base somewhat cordate. Leaves opposite, entire, glabrous, lanceolate, obtuse, shortly petiolate for first few pairs, not glaucous. First pr. 1·1 × 0·5, petiole 0·2; second 1·8 × 0·6, petiole 0·2 cm. Stem terete, glabrous. First internode 0·7, second 0·8 cm.

This specimen resembles, in the seedling, that of *E. paludosa*, but the cotyledons are smaller, and the leaves narrower. From that of *E. Gunnii*, it is quite distinct, its primary leaves not being at all like the sessile, ovate, glaucous ones of that species.

ii.(*d*). Eucalypts with very small cotyledons, transversely oblong or triangular, with slight or no emargination.

This group shades off from the previous one, and, in many cases, it is hard to put a species in one or the other. Practically all contain eucalyptol in a greater or less amount, many contain pinene, and others aromadendral and phellandrene. Piperitone is absent. In this class, the cotyledons have been reduced to their smallest dimensions, in contrast to the relatively enormous cotyledons of *E. calophylla*. The reason for this will be discussed later.

E. nova-anglica Deane & Maiden(Pl. xlii., fig.5).—Cotyledons very small, transversely oblong, petiolate. Leaves entire, opposite, glabrous, glaucous, lanceolate and shortly petiolate, then ovate, sessile, cordate, obtuse. First pr. 0·5 × 0·15, petiole 0·2; second 1·2 × 0·4, petiole 0·2; third 1·7 × 0·8 cm, sessile. First internode 0·7, second 1·2, third 1·1 cm. Stem terete, glabrous.

This species is interesting in that, although the oil contains only pinene, in that respect being only of the primitive type, and so allied to the *Corymbosa*-group, yet the cotyledons, leaves, and fruit are of the higher type.

E. Fletcheri R. T. Baker(Pl. lix., fig.4 .—Cotyledons small, transversely oblong, emargination slight or none. Leaves opposite, entire, glabrous, petiolate, lanceolate, obtuse. Mr. Baker has pointed out that this is distinct from *E. polyanthema*. The seedling confirms this, as the latter has bifid cotyledons.

E. Bosistoana F.v.M.(Pl. lxvii., fig.2).—Cotyledons small, obtusely oblong, slightly emarginate, often asymmetrical. Leaves opposite, soon alternate, entire, glabrous, lanceolate, petiolate, obtuse. First pr. 0·6 × 0·2, petiole 0·3; second 1·6 × 0·8, petiole 0·7; third 3 × 1·2, petiole 0·9 cm. First internode 0·3, second 0·5, third 0·7 cm. Stem terete, glabrous.

E. intertexta R. T. Baker(Pl. xliv., fig.3).—Cotyledons as in *E. Fletcheri*. Leaves opposite, entire, glabrous, narrow-lanceolate, acute, petiolate. Stem terete, glabrous.

E. conica Deane & Maiden(Pl. xliv., fig.6).—Cotyledons very small, triangular, emargination practically absent, petiolate. Leaves opposite, entire, glabrous, lanceolate, petiolate, obtuse. Stem glabrous, terete.

E. dealbata A. Cunn.(Pl. xlvi., fig.1).—Cotyledons small, obtusely oblong, slightly emarginate, petiolate. Leaves opposite, entire, glabrous, lanceolate, obtuse, petiolate. First pr. 0·9 × 0·25, petiole 0·2; second 1·8 × 0·7, petiole 0·3; third 2·5 × 0·7, petiole 0·25 cm. First internode 0·5, second 0·5, third 0·7 cm. Stem terete, glabrous.

E. tereticornis var. *linearis* R. T. Baker(Pl. xlvi., fig.2).—Cotyledons very small, transversely oblong, emarginate. Leaves opposite, entire, glabrous, narrow-lanceolate, subacute, shortly petiolate.

E. maculosa R. T. Baker (Pl. xlvi., fig. 3).—Cotyledons small, transversely oblong, obtuse, emargination almost absent, lamina 0·3 × 0·15, petiole 0·15 cm. Leaves opposite, entire, glabrous, narrow-lanceolate, tapering into a short petiole, subacute. Stem terete, glabrous.

E. Macarthuri Deane & Maiden(Pl. lxiv., fig.5).—Cotyledons transversely oblong, obtuse, emargination almost absent, 0·35 × 0·15, petiole 0·15 cm. Leaves opposite, entire, glabrous, lanceolate then ovate-lanceolate, then ovate and cordate, obtuse.

E. rostrata Schlecht.(Pl. lviii., fig.2).—Cotyledons small, transversely oblong, emargination almost absent. Leaves entire, opposite, soon alternate, lanceolate, obtuse, petiolate, glabrous.

E. ovalifolia R. T. Baker(Pl. lviii., fig.3).—Cotyledons very small, transversely oblong, shortly petiolate. Leaves opposite, entire, glabrous, petiolate, lanceolate then ovate, obtuse.

E. odorata Behr (Pl. lv., fig.5).—Cotyledons transversely oblong, obtuse, emargination almost absent. Leaves opposite, entire, glabrous, lanceolate, petiolate, acute. First pr. 0·7 × 0·25, petiole 0·2; second 1 × 0·4, petiole 0·3; third 1·5 × 0·6, petiole 0·4 cm. First internode 0·7, second 1·2, third 1·3 cm. Stem terete, glabrous.

E. Behriana F.v.M.(Pl. xlv., fig.4).—Cotyledons small, transversely oblong or triangular, petiolate, emargination slight or absent. Leaves opposite, entire, glabrous, lanceolate then ovate-lanceolate, obtuse, petiolate, lateral veins oblique.

E. sp.nov., R. T. Baker(Pl. liv., fig.4).—Cotyledons very small, of same form as *E. Behriana*. Leaves entire, opposite, lanceolate, obtuse, petiolate, glabrous. First pr. 0·25 × 0·5, petiole 0·15; second 0·35 × 0·1, petiole 0·2; third 0·6 × 0·2, petiole 0·25; fourth 0·5 × 0·3, petiole 0·3 cm. First internode 0·4, second 0·3, third 0·4, fourth 0·4. Stem terete, glabrous.

E. polybractea R. T. Baker(Pl. liii., fig.3).—Cotyledons resemble those of *E. Behriana*. Leaves opposite, entire, glabrous, narrow-lanceolate, subacute, petiolate. First pr. 0·4 × 0·05, petiole 0·2; second 0·9 × 0·15, petiole 0·3; third 1·2 × 0·3, petiole 0·3; fourth 2 × 0·3, petiole 0·3 cm. First internode 0·6, second 0·7, third 0·8, fourth 1 cm. Stem terete, glabrous. The cotyledons easily distinguish this species from most of the other "Mallees," as *E. dumosa*, *E. cneorifolia*, *E. oleosa*, etc.

E. viridis R. T. Baker(Pl. lvi., fig.2).—Cotyledons very small, of same shape as *E. Behriana*, but much smaller. Leaves entire, opposite, glabrous, linear-lanceolate, petiolate, subacute. First pr. almost linear; second 0·8 × 0·1, petiole 0·3; third 1·8 × 0·25, petiole 0·3; fourth 2·7 × 0·3, petiole 0·3 cm. First internode 0·4, second 0·4, third 0·7, fourth 0·6 cm. Stem terete, glabrous.

E. Woollsiana R. T. Baker(Pl. lvi., fig.3).—Cotyledons as in *E. viridis*. Leaves opposite, entire, glabrous, linear-lanceolate then lanceolate, broader than in *E. viridis*, petiolate, obtuse. First pr. 0·5 × 0·1, petiole 0·3; second 1·2 × 0·2, petiole 0·3; third 2 × 0·5, petiole 0·4; fourth 2·1 × 0·7, petiole 0·3 cm. First internode 0·5, second 0·8, third 1·7, fourth 1·6 cm. Stem terete, glabrous. Cotyledons are very much smaller than in *E. hemiphloia* and *E. albens*. First two pairs of leaves are also smaller.

E. pulverulenta Sm.(Pl.lxvi., fig.7).—Cotyledons transversely oblong, obtuse, emargination very slight or absent, 0·25 × 0·15, petiole 0·2 cm. Leaves opposite, entire, glabrous, short, ovate-lanceolate then ovate or oval, obtuse, subsessile, then sessile. First pr. 0·5 × 0·25, second 0·6 × 0·3, third 0·9 × 0·4, fourth 1 × 0·7 cm. First internode 0·4, second 0·6, third 1, fourth 1 cm.

E. Morrisii R. T. Baker(Pl. xlviii., fig.4).—Cotyledons transversely oblong, obtuse, asymmetrical, very slightly emarginate, lamina 0·3 × 0·15, petiole 0·3 cm. Leaves opposite, entire, glabrous, narrow-lanceolate, tapering into a short petiole, obtuse then subacute. First pr. 0·7 × 0·2, petiole 0·2;

second 1·3 × 0·3, petiole 0·2; third 1·9 × 0·35, petiole 0·2 cm. First internode 0·6, second 0·9, third 1 cm. Stem terete, glabrous.

E. Rodwayi Baker & Smith(Pl. l., fig.3).—Cotyledons smaller than in *E. Macarthuri*, and of different form, being transversely oblong, obtuse, 0·22 × 0·15, petiole 0·17 cm. Leaves entire, opposite, glabrous, pale green, lanceolate then oval-lanceolate, obtuse, subsessile. First pr. 0·7 × 0·2, petiole 0·2 cm.; second 1 × 0·45, subsessile; third 1·4 × 0·6 cm. First internode 1, second 0·6, third 0·8, fourth 1 cm. Stem terete, glabrous.

E. affinis Deane & Maiden(Pl. xliii., fig.5; Pl. lxix., fig.15).—Cotyledons as in *E. conica*, very small, shortly petiolate. Leaves entire, opposite, glabrous, lanceolate, subacute, petiolate, pale green.

E. rubida Deane & Maiden(Pl. xliii., fig.7; Pl. lxix., fig. 16).—Cotyledons small, slightly or hardly at all emarginate, cordate at base, 0·3 × 0·15, petiole 0·15 cm. Leaves entire, opposite, glabrous, glaucous, lanceolate then ovate, obtuse, subsessile. First internode 0·7, second 1·2, third 1·3 cm. First pr. of leaves 0·7 × 0·2, petiole 0·2; second 1·1 × 0·4, subsessile; third 1·7 × 0·8 cm.

E. camphora R. T. Baker(Pl. xlvii., fig.1).—Cotyledons very small, transversely oblong, slightly emarginate, obtuse, shortly petiolate. Leaves opposite, entire, glabrous, lanceolate, then ovate or oval, obtuse, subsessile then shortly petiolate.

E. tereticornis Sm.(Pl.lxvii., fig.1).—Cotyledons transversely oblong, very slightly emarginate, 0·25 × 0·15, petiole 0·2 cm. Leaves entire, opposite, glabrous, lanceolate, obtuse, petiolate, becoming broader till ovate or orbicular. First pr. 0·7 × 0·25, petiole 0·2; second 1·2 × 0·5, petiole 0·4; third 1·5 × 1, petiole 0·5 cm. First internode 0·6, second 0·7, third 1 cm.

E. Parramattensis C. Hall(Pl. lxvii., fig.4).—Proc. Linn. Soc. N.S.Wales, 1912, xxxvii.

E. aggregata Deane & Maiden(Pl. lxvii., fig.6).—Cotyledons very small, transversely oblong, very slightly emarginate, shortly petiolate. Leaves entire, opposite, glabrous, lanceolate, subacute, subsessile, pale green.

E. acaciæformis Deane & Maiden(Pl. lxviii., fig.3).—Cotyledons small, transversely oblong, slightly emarginate, 0·2 × 0 12, petiole 0·25 cm. Leaves opposite, entire, glabrous, lanceolate, obtuse, tapering into a short petiole, then subsessile.

ii.(*e*). Cotyledons larger than in Group ii.(*c*), more deeply emarginate, with divergent lobes. In many, the primary leaves are sessile and glaucous.

E. eudesmioides F.v.M.(Pl. lv., fig.7).—Cotyledons deeply bifid, with divergent lobes, which are obtuse and narrowed at their junction, lamina 0·6 × 0·2, petiole 0·25 cm. Leaves opposite, entire, ovate, obtuse, petiolate. First pr. 0·5 × 0·2, petiole 0·3 ; second 1 × 0·6, petiole 0·3 cm. Leaves and stem covered with short glandular hairs. First internode 0·4, second 0·3 cm.

E. Lehmanni Preiss(Pl. lv., fig.2).—Cotyledons of same form as in *E. eudesmioides* but smaller, 0·5 × 0·17, petiole 0·25 cm. Leaves opposite, entire, ovate, obtuse, petiolate. Leaves and stem covered with short glandular hairs.

E. cosmophylla F.v.M.(Pl. lv., fig.1).—Cotyledons moderately emarginate, cordate at base, lobes obtuse, lamina 0·5 × 0·25, petiole 0·3 cm. Leaves entire, opposite, glabrous, petiolate, ovate, obtuse, venation somewhat oblique, parallel, intramarginal vein away from edge. First pr. 1 × 0·45, petiole 0·4 ; second 2 × 1·1, petiole 0·5 ; third 3·3 × 1·8, petiole 0·5 cm. First internode 0·6, second 0·5, third 0·5, fourth 0·6 cm. Stem terete, glabrous.

E. hemilampra F.v.M.(Pl. xlv., fig.1).—Cotyledons fairly deeply bifid, lobes very divergent, obtuse, lamina 0·6 × 0·25, petiole 0·45 cm. Leaves entire, opposite, alternate after third pr., glabrous, obtuse, lanceolate, petiolate, lateral veins somewhat oblique and parallel, under sides of leaves paler. First pr. 1·2 × 0·45, petiole 0·3 ; second 1·8 × 0·6, petiole 0·5 ; third

3·6 × 1·2, petiole 0·6; fourth 5·4 × 1·5, petiole 0·5 cm. First internode 1, second 0·8, third 1·3, fourth 1·2 cm.

E. corynocalyx F.v.M.(Pl.xlv., fig.2; Pl. lxix., fig.17).—Cotyledons deeply bifid, the lobes diverging at an angle of about 110°, and obtuse, lamina 0·8 broad, petiole 0·5 cm., gradually merging into lamina. Leaves opposite but soon alternate, glabrous, pale on underside, ovate to orbicular, obtuse, sometimes emarginate at apex, petiolate, venation very oblique. First pr. 1 × 0·5, petiole 0·6; second 1·8 × 0·9, petiole 0·9; third 1·5 × 1·2, petiole 0·6 cm. Stem terete, glabrous.

E. elæophora F.v.M.(Pl. liii., fig.1; Pl. lxix., figs.18 and D) —Cotyledons moderately emarginate, lobes obtuse, asymmetrical, base cordate, lamina 0·75 × 0·3, petiole 0·3 cm. Leaves opposite, entire, glabrous, subsessile then sessile, lanceolate then ovate-lanceolate, obtuse, glaucous. First pr. 1·5 × 0·45, petiole 0·18; second 2·4 × 1, subsessile; third 2·7 × 1·2 cm. First internode 1·2, second 1·8, third 2·5, fourth 2·5 cm. Stem terete, glabrous.

E. goniocalyx F.v.M. (Pl. xlvi., fig.6).—Cotyledons resemble those of *E. elæophora*, but are smaller, and the lobes generally more symmetrical, laminæ 0·5 × 0·25, petiole 0·2 cm. Leaves opposite, entire, glabrous, glaucous, lanceolate and subsessile, then sessile, cordate at base, stem-clasping, obtuse or subacute. First pr. 0·9 × 0·25, second 1·8 × 0·6, fourth 3 × 0·9 cm. First internode 0·8, second 1·8, third 1·8 cm. Stem terete at base, then quadrangular, glaucous.

This species and *E. elæophora* are much alike, and have been confused, but, in the seedling, the cotyledons of *E. goniocalyx* are smaller, and the leaves are darker when dry, and are longer and more lanceolate, cordate, with rounded auricles and stem-clasping.

E. Bridgesiana R. T. Baker(Pl. xlvi., fig.5).—Cotyledons as in *E. goniocalyx*, but lobes often unsymmetrical. Leaves entire, opposite, glabrous, glaucous, lanceolate then ovate-lanceolate, obtuse, subsessile or sessile. First pr. 1·1 × 0·45,

sessile; second 3 × 1, third 3·3 × 1·2 cm., subsessile. First internode 1, second 1·2, third 2·4 cm. Stem glabrous, glaucous, quadrangular at the nodes, terete at internodes.

The seedling of this species is quite distinct from that of *E. Stuartiana*, which has the cotyledons almost without emargination, and the first leaves ovate, quite sessile, cordate, stem-clasping.

E. urnigera Hook. f. (Pl. li., fig.1).—Cotyledons as in *E. globulus*, but not so deeply emarginate, and consequently less lobed, the lobes also being more divergent, purplish beneath, lamina 0·9 × 0·25, petiole 0·2 cm. Leaves entire, opposite, glabrous, lanceolate then lanceolate-ovate, obtuse, sessile, purplish on undersides. First pr. 0·8 × 0·3, subsessile, alternate, subacute; second pr. 1·2 × 0·45, sessile; third 1·5 × 1 cm.

The shape of the cotyledons and the sessile leaves support the chemical evidence that this belongs to the *globulus*-group, while the urnshaped fruits indicate a return towards the more primitive type of the *corymbosa*-group.

E. unialata Baker & Smith (Pl. li., fig.2).—Cotyledons emarginate, lobed, the lobes obovate-oblong, greatly diverging, asymmetrical, purplish beneath, lamina 0·7 × 0·2, petiole 0·3 cm. Leaves opposite, entire, glabrous, glaucous, ovate-lanceolate, subsessile then sessile, obtuse, cordate at base with rounded auricles. First pr. 2·1 × 0·6, subsessile; second 2·7 × 0·9, sessile; third 3·6 × 1·1 cm. First internode 1·8, second 2·5, third 2·5 cm. Stem greenish, sometimes slightly glaucous, glabrous, at first terete, then quadrangular at the nodes.

This species may be distinguished, in the seedling, from *E. Maideni* in having the emargination of the cotyledons not so deep, and consequently the lobes are not so constricted at their junction; the first pair of leaves larger and broader than in *E Maideni*, and there is not so much glaucousness on the leaves and stem.

E. Maideni F.v.M. (Pl. xlviii., fig.1).—Cotyledons deeply bifid, lobes obovate, diverging, constricted at junction. Leaves opposite, entire, glabrous, glaucous, lanceolate then ovate-

lanceolate, subsessile then sessile, cordate at base, obtuse. First pr. 0·7 × 0·2, petiole 0·2; second 2 × 0·35, subsessile; third 3·3 × 1 cm. First internode 0·8, second 1·0, third 1·2, fourth 2·5 cm.

E. globulus Labill.(Pl. xlviii., fig.3; Pl. lxix., fig.B).—This has been described in Lubbock's "On Seedlings." I would point out that the leaves of the first pair are narrower, and proportionately longer than in *E. Maideni* and *E. unialata*.

E. sp. nov., R. T. Baker(Pl. lxviii., fig.4; Pl. lxix., fig.19). —Cotyledons fairly deeply emarginate, the lobes asymmetrical, obovate-oblong and obtuse, cordate at base, purple on undersides, 0·9 × 0·3, petiole 0·4 cm. Leaves entire, opposite, glabrous, glaucous, ovate, obtuse, sessile, cordate at base, stem-clasping. First pr. 1·8 × 0·7, second 2 × 1·0, third 2·4 × 1·4 cm. First internode 1·4, second 1, third 1·1 cm. Stem glabrous, terete, purplish at first, then quadrangular as in *E. globulus*. This species plainly belongs to the *globulus*-class, and the cotyledons are very similar, but the emargination is not so deep in this species, hence the lobes are more obtuse and almost in a straight line. The leaves are more glaucous and much broader, being ovate and obtuse.

E. gomphocephala DC.(Pl. liv., fig.3; Pl. lxix., fig.20).— Cotyledons deeply bifid, lobes diverging at an angle of 120 degrees, obtuse, asymmetrical, lamina 0·7 cm. across, petiole 0·6 cm. Leaves entire, opposite, glabrous, obtuse, petiolate. First pr. 1·1 × 0·5, petiole 0·3; second 1·8 × 0·8, petiole 0·3 cm. First internode 0·5, second 0·4, third 0·4 cm. The cotyledons of this species show transit from others in this group, such as *E corynocalyx*, to *E. cornuta* and thence to those with still narrower lobes or limbs, as *E. redunca*.

ii.(*d*) Cotyledons so deeply bifid as to represent the letter Y. Lobes narrow to linear, and as long as, or even longer than the petiole. Leaves generally petiolate and glabrous.

E. cornuta Labill.(Pl. liv., fig.2; Pl. lxix., fig.21).—Cotyledons deeply bifid, the lobes unequal and narrower than in

E. gomphocephala, and at an angle of 120°. Longer lobe 0·6 in length, petiole 0·25 cm. Leaves alternate after first pair, entire, petiolate, obtuse, ovate or orbicular, dark green on upper surface, glabrous. Stem terete, glabrous.

E. polyanthema Schau.(Pl. xlix., fig.3).—Cotyledons Y-shaped, limbs very narrow, 0·2, petiole 0·2 cm Leaves lanceolate, then ovate-lanceolate, acute, petiolate, glabrous, opposite till fourth pair, entire, dark green. Stem terete, glabrous.

E. occidentalis.—See Lubbock's "On Seedlings."

E. salubris F.v.M.(Pl. xlix., fig.4 ; Pl. lxix., fig.24).—Cotyledons Y-shaped, the limbs contracted at junction and 2 mm. long, petiole 2 mm. Leaves opposite, entire, glabrous, lanceolate, acute, petiolate. First pr. 1 × 0·15, petiole 0·2 ; second 2·5 × 0·5, petiole 0·3 ; third 2·7 × 0·5, petiole 0·5 cm. First internode 0·2, second 0·3, fourth 0·4 cm. Stem terete, glabrous.

E. leptopoda Benth.(Pl. lii., fig.4).—Seedling greatly resembles that of *E. salubris*, but the leaves are of a slaty-grey colour when dry, the internodes longer, and the cotyledons have a longer petiole.

E. loxophleba Benth. (Pl. lv., fig. 4).—Cotyledons Y-shaped limbs narrow, 0·25, petioles 0·5 cm. Leaves entire, glabrous, opposite, soon alternate, linear then lanceolate, acute, petiolate, internodes long.

E. redunca Schau.(Pl. l., fig.2).—Cotyledons as in *E. loxophleba*. Leaves opposite, entire, glabrous, petiolate, lanceolate, acute.

E. salmonophloia F.v.M. (Pl. liii., fig. 5).—Cotyledons Y-shaped. Limbs linear, 0·2, petiole 0·4 cm. Leaves opposite, entire, linear then linear-lanceolate, tapering into a short petiole, covered with short, glandular hairs, acute. Stem with fine, short, glandular hairs.

E. oleosa F.v.M.(Pl. liii., fig.4).—Cotyledons Y-shaped, limbs longer and wider than in *E. salmonophloia*, constricted at junction. Leaves linear then lanceolate, shorter and more acute than in *E. salmonophloia*, the first two pairs sessile.

E. cneorifolia DC.(Pl. liii., fig.6).—Cotyledons as in *E. oleosa*. Leaves linear, then obovate-lanceolate, obtuse, subpetiolate, glabrous, opposite, after fifth pr. alternate. The leaves are quite distinct from those of the closely allied species in this group.

E. gracilis F.v.M.(Pl. liii., fig.7).—Cotyledons Y-shaped, limbs linear, 0·2, petiole 0·4 cm. long. Leaves linear and acute, then lanceolate and obtuse, opposite, entire, glabrous, tapering into a short petiole. First pr. 1·2, second 1·6, third 1·8, fourth 2·4 cm. First internode 0·6, second 0·5, third 0·8, fourth 0·5 cm. Stem terete, glabrous.

E. pendula A. Cunn.(Pl. xlix., fig.2; Pl. lxix., fig.23).—Cotyledons Y-shaped, the limbs linear and 0·18 cm. long, petiole 0·3 cm. Leaves opposite but soon alternate, glabrous, entire, acute then subacute, linear then lanceolate, shortly petiolate. Internodes longer than in *E. gracilis*.

E. calycogona Turcz.(Pl. lxvi., fig.5; Pl. lxix., fig.22).—Cotyledons Y-shaped, limbs narrowly obovate, asymmetrical, 0·25 cm. long, petiole 0·5 cm. long. Leaves opposite, then after few pairs alternate or even becoming alternate in first pair, entire, glabrous, linear and acute, then lanceolate and subacute, distinctly petiolate. First pr. 1·1 × 0·15, petiole 0·3; second 1·3 × 0·25, petiole 0·3; third 1·5 × 0·3, petiole 0·3 cm. First internode 1·1, second 1, third 0·9 cm. Stem terete, greenish, glabrous.

This species is quite distinct from *E. gracilis* in the seedling, and thus receives confirmation of the evidence for its specific rank. The limbs of the cotyledons are obovate instead of linear as in *E. gracilis*, while the leaves are more characteristically lanceolate and petiolate than in that species. The internodes too are generally longer.

E. uncinata Turcz.(Pl. lxvi., fig.6).—Cotyledons Y-shaped, limbs almost linear but not so narrow as in *E. gracilis*, 0·25 cm. long. Petioles flattened and greenish in their outer half, 0·6 cm. long. Leaves entire, opposite, glabrous, linear or narrowly oblong-linear, obtuse, tapering into a short petiole.

E. squamosa Deane & Maiden(Pl. xlix., fig.5; Pl. l.,fig.1; Pl. lxix., figs.25, C, D).—Cotyledons Y-shaped, more deeply bifid than in any species yet examined, limbs contracting at junction, obtuse, 0·6 to 0·7 cm. long, petiole 0·5 to 0·6 cm. long. Leaves opposite but soon alternate, entire, glabrous, linear then lanceolate or ovate-lanceolate, acute then subacute, and ending in an apical point, petiolate, glaucous. Stem terete, glabrous, slightly glaucous. First pr. leaves 1·8 × 0·2, petiole 0·3; second 1·8 × 0·3, petiole 0·4; third 2·6 × 0·5, petiole 0·4; fourth 2·6 × 0·8, petiole 0·6; fifth 3 × 1·2, petiole 0·6 cm., alternate. First internode 1·4, second 1·2, third 1·2, fourth 1 cm.

The slight glaucousness of stem and leaves is worthy of note.

The relation of the groups of the seedlings to the morphology, chemistry, and geographical distribution of the various species, we are now in a position to touch on. I have shown that the *corymbosa*-group is characterised by seedlings with reniform cotyledons, and characteristic primary leaves; but, from the researches of Messrs. Baker & Smith, we know that the mature leaves have the lateral veins transverse to the midrib, and closely set and parallel to one another, and that they yield a pinene oil without eucalyptol, points they share in common with the Angophoras. We also know that the cells of the anthers are parallel and open by longitudinal slits, the flowers corymbose, fruits urceolate and valves deeply enclosed, and that they grow in the warmer, moister, coastal parts of Eastern and Northern Australia, only *E. calophylla* and *E. ficifolia* having penetrated to South-Western Australia. It will probably be found that the other species closely allied to *E. corymbosa*, such as *E. Abergiana*, *E. clavigera*, *E. dichromophloia*, *E. ferruginea*, *E. Foelscheana*, *E miniata*, *E. peltata*, *E. phœnicea*, *E pyrophora*, *E. ptychocarpa*, *E. setosa*, *E. terminalis*, and *E. Watsoniana* will yield seedlings of the same type.

Although the Stringybark-group exhibits such uniformity of resemblance in the seedlings, and also in its other morphological

characters, the chemical constituents of the oils vary greatly. Thus we find *E. lævopinea*, *E. dextropinea*, and *E. Wilkinsoniana* give pinene oils; *E. eugenioides* a pinene-eucalyptol oil; *E. macrorhyncha*, *E. capitellata* and *E. nigra* a pinene-eucalyptol-phellandrene oil; and *E. obliqua* a phellandrene-piperitone oil. While not departing greatly from the general form of the group, they have, unlike the Corymbosas, been able to adapt themselves to very varying climatic and physical conditions, as many of them occur in cool, elevated situations; and this they seem to have been able to accomplish, not by morphological change, but by virtue of the oils they elaborate. The presence of phellandrene seems to give, those possessing it, the power to flourish in a cool climate. *E. eugenioides* is the most widely distributed member of the group, being able to exist under very varying conditions of climate and soil. It is very likely that it has been enabled to do this by the help of its comparatively small cotyledons, and its eucalyptol-pinene oil.

Among the emarginate cotyledonary groups, one of the most striking is (*b*), which might, for convenience, be called the "Peppermint"-group, as many members contain piperitone, while others contain pinene, phellandrene, and eucalyptol in varying proportions. It is noteworthy that aromadendral, the characteristic constituent of the "Boxes," is almost entirely absent. The cotyledons in this group are characteristically quadrilateral and the emargination is always slight and sometimes practically absent. Another interesting point is that most of the members of this group have reniform anthers, and many of them a characteristic venation, which may be seen even in the primary leaves, the lateral veins being very oblique, in fact almost parallel to the midrib, and forming a looped arrangement with the intramarginal vein, which is away from the edge. In the case of *E. Rossii*, the evidence of the seedling is useful, as it explains the apparent anomaly of the chemical composition, as this, while giving a eucalyptol-pinene oil, and being classed chemically with species which have generally parallel anthers and a different venation, yet itself has reniform anthers, and a venation more characteristic of the piperitone-group. I would also point out that, while

E. stricta chemically has some relationship to the *E. cneorifolia*-group, yet, morphologically, it has a close relationship to the Peppermint-group, and possesses reniform anthers; and the form of the seedling strongly supports this The seedling of *E. apiculata* also shows its affinity to the Peppermints. It is worth while to draw attention to the fact that the majority of the species with reniform anthers, belong to this group or to the Stringybark-group with entire cotyledons. The members of this group, too, are confined to the Dividing Range and Coastal Districts of Eastern Australia, and some occur also in Tasmania, in other words, in places where the rainfall is fairly abundant, and the climate cold or temperate. Some of them, such as *E. coriacea*, occur in Alpine regions. The deep purplish-red coloration of the cotyledons and leaves seems to be connected with this climatic preference, and may be in response, but cannot be solely due to resistance to cold, because, in *E. coriacea* and *E. stellulata*, two most characteristic Alpine species, it is practically absent.

Let us now take the three large groups, ii.c^1, c^2, c^3. These may be considered to merge, more or less, one into the other, as I have arranged the grouping mainly by the size of the cotyledons. The primary leaves are generally smooth, and either petiolate or sessile, and, if the latter, generally glaucous. Those with the longer cotyledons and glaucous, sessile leaves generally occur in the cold, mountainous regions; and it has been argued that the glaucous bloom is a protection against cold, but against this we must remember that the same condition is also found in species in the dry, hot parts of Australia, and especially of Western Australia, and, in that case, the argument cannot hold. Included in these groups are the " Ironbarks " and " Boxes," with anthers opening in pores; but the majority of the remainder have parallel anthers. While many of the members of these groups occur in the cool, mountainous and warm, moist, coastal regions, yet the great majority of these with the very small cotyledons occur on the western slopes, and in the hot, dry interior, and they seem to be a response to the dry conditions. I would here point out that, although the coastal and mountain regions of Eastern Australia enjoy a high average rainfall, yet even there it is no un-

common thing, especially in the period from August to February, for them to have prolonged times of quite severe drought, when they get very little more rain than in the interior, and vegetation is severely tested thereby. Moreover, it is not uncommon, in the lowlying coastal areas, to have hot westerly winds, raising the temperature to well over 100°F., and this would account for the presence of such species as *E. crebra* and *E. hemiphloia* so near the coast Attention has been drawn by various writers to the fact that *E. Smithii* and *E. microcorys* are aberrant forms, in that, while yielding a eucalyptol-pinene oil, they yet have reniform anthers. The former, I find, has cotyledons of the *globulus*-type, while the primary leaves remind one a great deal of those of *E. amygdalina*, and it may thus have a mixed ancestry. The cotyledons of *E. microcorys*, in shape, have a good deal of the "Peppermint"-type about them, but no purplish-red coloration; while the primary leaves are smooth and petiolate, such as we find in *E. propinqua* and other members of the group in which I have placed it. It, too, probably has a mixed ancestry. By reason of their yielding a pinene oil and having a transverse venation, Messrs. Baker and Smith placed *E. botryoides*, *E. robusta*, and *E. saligna* in the same chemical group as *E. corymbosa*, though, as regards the fruits and many other characters, they have little in common with it. The seedlings show that they are far removed, as they all have emarginate cotyledons, and smooth, petiolate leaves, and so have much more in common with such species as *E. resinifera*. Apart from these exceptions, almost the whole of these groups yield a eucalyptol-pinene oil, and this is the oil most characteristically associated with the emarginate cotyledons. A certain proportion also contain aromadendral, and some others phellandrene. *E. Macarthuri*, with its geranyl-acetate oil, belongs to the group with small cotyledons.

Most interesting of all is the group with the emargination developed to such an extent, that they may be termed the Y-shaped cotyledons. *E. cornuta* seems to connect, through *E. gomphocephala*, with the *globulus*-type. Species with this type of cotyledon seem to be most plentiful in Western Australia, and then to have spread across South Australia to the dry interior of

Eastern Australia. It does not seem to occur in the North and North-Eastern coastal areas of the continent, nor is it found on the high mountain-ranges nor in Tasmania. It is a dry-country type, and many of these species are Mallees; in fact, all the Mallees have either this kind of cotyledon, or the small, oblong, round or reniform cotyledon. The origin of the peculiar rootstock of the Mallee can be well seen by observing the seedling. In nearly all the Eucalyptus seedlings, and also in the Angophoras, there is developed, especially if growth is checked, a small woody swelling in the stem at the point of attachment of the cotyledons. A number of buds will develop on this, and shoots start from them. If the growth of the seedling proceeds in the form of one main stem, this swelling is soon obliterated, but, in the Mallee, these secondary shoots grow almost as quickly as the main stem, and so, instead of a tree in the ordinary sense, we have an enlarged rootstock, from which spring numerous stems, all more or less of the same size. As far as known, the oils of this group contain eucalyptol and pinene, and many of them aromadendral; phellandrene is quite absent. Almost all belong to the Parallelantheræ, *E. uncinata*, of the Porantheræ, being an exception. Generally the anthers of these species are small.

Folding of the Cotyledons in the Embryo.

The shape and size of the seed are largely determined, when endosperm is absent, by the size, shape, and manner of folding of the cotyledons. Moreover, the size and shape of the fruits must be largely determined by the shape, size, and number of fertile and sterile seeds they contain. In *Angophora*, the fruits are large to accommodate the single, large, flat, fertile seed in each cell. So, too, with the "Bloodwoods," where there is one fertile seed in each cell, and a few sterile ones. The occurrence of the single fertile seed permits of the development of the winged appendage of the testa, many of the members of this group possess, and which is impossible in the smaller fruits, with closely packed seeds, of the majority of the Eucalypts.

Three main types of folding may be distinguished:

(i.) That found in *E. corymbosa*, and those species with similar, entire, reniform cotyledons. Here the fold in each cotyledon

takes place along the median vein, from petiole to apex. Each folds transversely, thus, into two halves, and one half of each cotyledon lies between the two halves of the other, the radicle lying in the centre between the two innermost halves of each, and at the lower pole of the seed. One half of each, consequently, lies against the testa. The lobed portion at the intero-lateral angle of each half serves to ensheath the radicle. The apex of the seed is occupied by the two apices of the cotyledons. In germination, the radicle emerges from the lower pole, and rupture of the testa then takes place along the keeled, dorsal margin of the seed. We thus see that, in the embryo, each cotyledon has an enveloping half, which lies against the testa, and an enveloped half, which lies against the radicle. In the *corymbosa*-type, these are usually symmetrical. Similar folding occurs in the Angophoras.

(ii.) *E. globulus* may be taken as the type of the moderately emarginate cotyledon. Comparing it with the reniform cotyledon of *E. corymbosa*, we see that it is as if a deep slice had been taken out of the apical portion of the latter, leaving only the intero-lateral, lobed portion of each half, which, as we have just seen, ensheaths the radicle. Folding still takes place along the line of the central vein, which is now very short; consequently, instead of being folded transversely, the halves of the cotyledons are now deflexed and convolute over the radicle. It will thus be seen, that the radicle is still embraced by the lobed portion of one-half of each cotyledon, the other half of each lying against the testa. The apex of the seed, however, now contains the two lines of fold, which, in *E. corymbosa*, are along each lateral margin of the seed. They have, therefore, moved up to the apex. In *E. globulus* and many similar species, the enveloped half of each cotyledon is smaller than the enveloping, hence causing the cotyledons to be asymmetrical; in the seedling, each larger half being opposite each smaller. In *E. marginata*, with its large, slightly emarginate, obcordate, asymmetrical cotyledons, the folding is transverse, the smaller half of each cotyledon being enveloped within the doubled-over other cotyledon. Though the base is cuneate, in the embryo the lateral

lobes are brought downwards so as to ensheath the radicle, which is short and thick, while the petioles are also short. In germination, the hypocotyl remains subterranean, no growth of it taking place as is usual in the other Eucalypts, but, to compensate for this, great growth and elongation of the petioles occurs, thus carrying the cotyledons well up above the ground. This is the reason *E. emarginata* has cotyledons with longer petioles than any other Eucalypt.

(iii.) In the Y-shaped cotyledons, such as of *E. squamosa*, the folding is still further modified. One limb of each cotyledon passes through the notch in the other, and thus interlocked, all four bend downwards to embrace the radicle, which, consequently, is now in contact with all four limbs, not with the inner two, as occurs in the other methods. The outer surface of all four is in contact with the testa. It will thus be seen that the plumule is very well protected by the interlocking of the limbs, and thus it and the radicle are able to withstand dessication. Figures A, B, C, of Plate lxix., illustrate diagrammatically a transverse section through the lower part of the embryo of each of the three types.

Third Cotyledon.—Very rarely, different species may be observed to possess three cotyledons. I have seen this in *E. coriacea*, *E. elæophora*, *E. eximia*, *E. Bosistoana*, *E. pilularis*, *E. Stuartiana*, and *E. microcorys*. The primary leaves are then generally in whorls of three, and when they become alternate, the tripartite arrangement is obscured. Again, after being in whorls of three, they may revert to the paired arrangement. In both these instances, a division of the embryo into three has occurred. Again, three cotyledons may be followed by paired leaves, showing that one cotyledon has been subdivided. I have even observed a pair of cotyledons followed by leaves in whorls of three. This tripartite arrangement, I have also observed in *Angophora lanceolata*, and it is common in hybrid Carnations.

Primary Leaves.—This research has established, beyond all doubt, that the so-called "sucker"-leaves are of the same form as the seedling-leaves, and has confirmed the opinion expressed by me in a paper on "The Eucalypts of Parramatta" [These Pro-

ceedings, Vol. xxxvii.] that the term primary or juvenile should always be adopted for the early type of foliage, and the term secondary, or adult, or mature for the later type of foliage. Whatever the juvenile type may be, the leaves tend very quickly, after the first pair, to assume that character. Where the primary leaf-type is sessile, it is usual for the first pair to be shortly petiolate. The leaves of the various species of the Corymbosa-group have a great resemblance to one another, being petiolate, alternate, often peltate, and covered with glandular hairs. In the Stringybark-group, the primary leaves are ovate-lanceolate, shortly petiolate or almost sessile, and also hairy. In the Peppermint-group, the leaves are usually sessile and smooth; while in *E. globulus* and its near relatives, they are sessile, smooth, and glaucous. The majority of the species with small cotyledons have smooth and petiolate, primary leaves. Those with Y-shaped cotyledons usually have almost linear leaves at first, these tapering into a short petiole. If a branch springs from the axils of the cotyledons, its leaves are always of the same form as those of the main stem. A curious abnormality of the leaves is often seen. It is symmetrical, and occurs in both members of a pair of the early leaves, and has been observed in a number of species. It consists of a rounding off and shortening of an otherwise subacute leaf, which terminates, instead, in a short, rounded boss. It is well illustrated in the figure of *E. melanophloia*, in Plate lxviii., fig.7.

Evolutionary Considerations.—Messrs. Baker & Smith, on botanical and chemical results, have outlined a scheme of the probable course of evolution of the Eucalypts; and Mr. E. C. Andrews has recently given us his views on "The Development of the *Myrtaceæ*." This research has demonstrated, in an unexpected way, the great part in the evolution taken by the cotyledon-leaves. *Tristania*, *Angophora*, and *Eucalyptus* probably all had a common ancestor. The two former failed to adapt themselves to the varying conditions of climate and soil, while *Eucalyptus* acquired that knack. The same type of cotyledon prevails in all the Angophoras, the same type of leaf and oil, and not being able to depart therefrom, they have not been able to spread far

afield, to leave the particular environment they affect. The group of the Eucalypts, that possesses the same type of cotyledon and oil, viz., the Corymbosa-group, has, in some manner or other, acquired the power of varying to some extent, by developing the vertical, petiolate leaf at an early stage, and by varying the size of the cotyledon. Chemically, they do not seem to have made much progress, and have failed to develop eucalyptol, phellandrene, piperitone, or aromadendral, and so have been unable to leave a sandstone-formation, or to penetrate to the high alpine regions or dry interior. They prefer plenty of moisture, but can resist heat, and so confine themselves to the warm, moist, tropical, coastal areas. Their large foliaceous cotyledons could germinate and maintain the young seedling, if plenty of moisture was available, and served to protect the young radicle just penetrating into the soil. To make their advance, the Eucalypts found it was necessary to reduce the size of the cotyledons, from such relatively enormous ones as those of *E. calophylla.* This was done in two ways: firstly, by a simple reduction in size; secondly, by cutting out portion of the cotyledon by the introduction of emargination. The first method, we see well illustrated in the Stringybarks. In *E. lævopinea*, *E. dextropinea*, and *E. Wilkinsoniana*, the oil is still a simple pinene one, and the primary leaves, shortly petiolate, still have the glandular hairs, but they have reduced the size of the cotyledons, and have managed to ascend to the mountainous cooler areas. *E. eugenioides* has reduced its cotyledons very greatly, and developed a eucalyptol-pinene oil, and so has been able to penetrate all the Eastern States, and, in a dwarf form, to exist on the high parts of the Blue Mountains, and it can grow on soil of almost any description.

E. macrorhyncha and *E. capitellata*, also with fairly reduced cotyledons, and by the development of a pinene-eucalyptol-phellandrene oil, have been enabled to spread over the South-Eastern States, and to work on to the mountains; while *E. obliqua*, by the development of a phellandrene-piperitone oil, has been able to establish itself over the mountains from the Queensland border to Southern Tasmania. *E. fastigata* and *E. regnans* are pro-

bably offshoots from the Stringybarks. Such forms of "entire" cotyledon as we see in *E. dumosa*, *E. incrassata*, *E. populifolia*, and *E. quadrangulata*, are either reductions, or, more probably, due to a return to the ancestral type after reduction through an emarginate ancestor. In the emarginate type of reduction, we see what the Eucalypts have found the most suitable, and so given the preference to. They evidently found it better to cut out and reduce, than to reduce only. In *E. marginata*, we see how the size, still great, has been slightly reduced by the emargination. In *E. Planchoniana*, the same obtains, and this species, with its parallel anthers, but an oil and leaves like those of *E. pilularis*, probably represents most closely the ancestral prototype of the group to which *E. pilularis*, with its reniform anthers and smaller cotyledons, belongs. I have represented diagrammatically in fig. D of Plate lxix., the reduction from the cotyledon of *E. corymbosa* to that of *E. elæophora* of the *globulus*-type. It will be seen that the lightly shaded, apical portion has been entirely removed, but the lobed part still remains. When one takes away, in addition, the deeply shaded lobed portion and the remainder of the part at the bottom of the notch, we have a cotyledon of the type of *E. cornuta*, leading up to *E. squamosa*. The narrowing of the angle and reduction of the size of the limbs have led to the extreme form of Y-shaped cotyledon seen in *E. gracilis* and *E. pendula*. From the predominance of such forms in Western Australia, it seems likely they arose there in the first instance, and gradually spread east along the Australian Bight. Hence we find, in the far west of New South Wales, and in Victoria and South Australia, such species as *E. gracilis*, *E. cneorifolia*, *E. pendula*, *E. uncinata*, *E. calycogona*, and *E. oleosa*. The most interesting of all of this type is *E. squamosa*. This occurs near Sydney on the Hawkesbury Sandstone, and also near Rylstone on the western slopes of the Dividing Range. It appears to be a retrograding species, as the moist conditions do not seem to be suitable; and everything points to its having migrated from the hot, dry west, and crossed the Dividing Range. The longer cotyledon-limbs indicate a response to the cooler, moister conditions. In the three subdivisions of the great

globulus-type of cotyledon, the larger cotyledons are usually found in the cool mountain-areas. Some of these are *E. globulus*, *E. Maideni*, *E. unialata*, and *E. urnigera*. This last species shows a peculiar atavistic character in its urn-shaped fruit, thus returning to the *corymbosa*-type. In the group of very small cotyledons, a great many, such as *E. viridis*, *E. rostrata*, *E. Woollsiana*, and *E. polybractea*, are found in the hot, dry interior. In the Peppermint-group, with the exception of *E. Planchoniana*, which is an aberrant member, a great uniformity of size exists among the cotyledons, and the emargination is slight or may be practically suppressed. When we come, however, to the species found on the higher mountains, such as *E. amygdalina*, *E. dives*, *E. radiata*, and especially *E. coriacea* and *E. stellulata*, we find that the cotyledons are considerably reduced in size; this on account of the great radiation, and keen, searching winds of these altitudes.

As Tasmania has been separated from the mainland for such ages, it is well to review the types of cotyledon occurring there. Those of the *globulus*-group are *E. globulus*, *E. urnigera*, *E. unialata*, *E. viminalis*, *E. Gunnii*, *E. Perriniana*, *E. cordata*, *E. Muelleri*, *E. acervula*, and *E. Rodwayi*, the last having the smallest cotyledons of all. In the Peppermint-group, there are *E. linearis*, *E. phlebophylla*, *E. Risdoni*, *E. Delegatensis*, *E. virgata*, *E. tæniola*, *E. coccifera*, and *E. amygdalina;* while in the Stringybark group, we have *E. obliqua* and *E. regnans*. The *corymbosa*- and Y-shaped groups are unrepresented.

The reason for all this great reduction in the large foliaceous cotyledons of the *E. corymbosa*-type, will now be evident. In a tropical climate, with fairly abundant rains, these would be the suitable type. But when droughty conditions and an abnormally dry atmosphere, with continuous, searching winds, had to be contended against, a reduction in size became necessary, so as to lessen the area of evaporation, and the area of exposure, both in the seed and in the germinating plant. Hence we get the very small, oblong cotyledon, as in *E. conica;* and the small Y-shaped one as in *E. pendula*, or, in a few cases, the very small round or reniform shape, as in *E. dumosa* and *E. incrassata*. As far as

seen, all the far inland species are of one or other of these types. *E. pendula* has the smallest, bifid cotyledons of all, yet has proved itself most eminently adapted to the dry interior of Australia, being found in New South Wales, Queensland, Victoria, South Australia, and Western Australia. The same is also true of *E. uncinata* and *E. oleosa*, also of this class.

Not only have the Eucalypts altered the *corymbosa*-cotyledon, but they have also changed from the urn-shaped fruit of that group, with its deeply enclosed valves, and contracted neck. It must have been found that the winged prolongation of the testa caused a difficulty in the exit of the seeds, on the opening of the valves. Accordingly, as evolution proceeded, the appendage was abandoned (in *E. corymbosa* itself, it has almost vanished), the everted rim was cut out, and the valves became higher and higher, till the ovary became quite domed, and the valves exserted after dehiscing. Thus the ready exit of the seeds was provided for.

Seed was obtained, from Mr. Staer, of *E. eudesmioides*, a member of the small group of Eucalypts found in North-Western Australia, which Robert Brown proposed to raise to generic rank under the name *Eudesmia*. The cotyledons of this species proved to have well marked emargination, with divergent lobes. The leaves were petiolate, opposite, and covered with glandular hairs. So although the opposite leaves, notched calyces, and peculiar stamens indicate characteristics of the early type of Eucalypts, the well marked emargination shows that they have undergone great evolutionary advance in that respect. Hence, in the former characteristics, they may have undergone a reversion to the earlier type, just as we see the same in the urn-shaped fruit of *E. urnigera*.

To sum up, then, the evidence of the seedlings of the Eucalypts, and especially of their cotyledon-leaves, agrees with the theory set forth by Messrs. Baker & Smith, based on their botanical and chemical results, that the Corymbosas are the most primitive group of the genus. Later chemical and botanical knowledge, and now the new light thrown by the cotyledons, will necessitate a recasting of the genealogical tree in "A Research on the

Eucalypts," which was stated, at the time, by the authors to be tentative. This examination of the seedlings strongly confirms the main principles laid down, however. The ancestor of the Corymbosas had comparatively large, entire, reniform cotyledons. In *E. calophylla*, we see the extreme in size. To meet Australian conditions, it was necessary to reduce the size, and this we see first in the Corymbosas themselves, till we get the smaller cotyledons of *E. trachyphloia*. The Stringybarks appear to have arisen as an offshoot of the Corymbosas, and have smaller cotyledons of similar type, and hairy, primary leaves, but have developed reniform anthers. At the extreme end of this group, *E. regnans*, with smoother leaves, has lost its "stringy" bark, while *E. fastigata*, its very near relative, retains it. It is difficult to say where emargination first arose. Traces of it are seen in *E. intermedia*; and *E. Planchoniana* and *E. marginata*, with large, emarginate cotyledons, may be descendants of the earlier examples of it. The former seems to be a transition-form to the great group of Peppermints, and their allies. It has cotyledons and primary leaves of the same type, but parallel anthers of the *corymbosa*-type. Chemically, it resembles *E. pilularis* and others of that group. The seedling of *E. Smithii* confirms its probable mixed ancestry. The cotyledons and oil are of the *globulus*-type, and the primary leaves and anthers betoken a relationship to *E. amygdalina*. If ever a species has claims to a hybrid ancestor, it has.

In the emarginate *globulus*-type, the rule has been to make a general reduction in size of the cotyledon. But in Western Australia, to combat the specially dry conditions there, a special type of cotyledon was evolved, of a deeply bifid form, and this has spread along the southern coast to Eastern Australia, and even up into the far western parts of Queensland. Accompanying these changes in the cotyledons, there has been a change in the essential oils. The *corymbosa*-type is associated with a pinene oil without eucalyptol. That of the Peppermint-group is associated with eucalyptol, phellandrene, and piperitone in varying proportions. The *globulus*-type of cotyledon is mainly associated with a eucalyptol-pinene oil, and in its reduced form aromaden-

dral frequently appears. Finally, the Y-shaped cotyledon is also usually associated with eucalyptol, pinene, and aromadendral. Eucalyptus is not merely a wonderful genus economically and botanically, it also yields important information to the student of Evolution, in that so many of its connecting links appear to have survived, and we are now in a better position to perceive the important part in that process, which has been taken by the cotyledons.

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EXPLANATION OF PLATES XXXVIII.-LXIX.

Eucalypt Seedlings.

Plate xxxviii.

Fig.1.—*E. calophylla* R.Br.; W.A.
Fig.2.—*E. intermedia* R. T. Baker; Mallangarell
Fig.3.—*E. trachyphloia* F.v.M.; Murrumbo.
Fig.4.—*E. corymbosa* Sm.; Parramatta.

Plate xxxix.

Fig.1.—*E. eximia* Schau.; Springwood.
Figs.2-3.—*E. perfoliata R.Br.*
Fig.4.—*E. marginata* Sm.; W.A.

Plate xl.

Fig.1.—*E. lævopinea* R. T. Baker; Armidale.
Fig.2.—*E. lævopinea*; Rydal.
Fig.3.—*E. lævopinea;* Lilydale, Vic.
Fig.4.—*E. dextropinea* R. T. Baker; Monga.

Plate xli.

Fig.1.—*E. Todtiana* F.v.M.; W.A.
Fig.2.—*E. Wilkinsoniana* R. T. Baker; Stroud.
Fig.3.—*E. umbra* R. T. Baker; Lismore.
Fig.4.—*E. umbra*; Lismore (later stage).

Plate xlii.

Fig.1.—*E. Muelleriana* A. W. Howitt; Victoria.
Fig.2.—*E. botryoides* Sm.; National Park.
Fig.3.—*E. saligna* Sm.; Parramatta.
Fig.4.—*E. robusta* Sm.; Parramatta.
Fig.5.—*E. nova-anglica* Deane & Maiden; Tenterfield.
Fig.6.—*E. diversicolor* F.v.M.; W.A.

Plate xliii.

Fig.1.—*E. maculata* Hook.; Smithfield.
Fig.2.—*E. eugenioides* Sieb.; Parramatta.
Fig.3.—*E. microcorys* F.v.M.; Tumbulgum.
Fig.4.—*E. propinqua* Deane & Maiden; Stroud.
Fig.5.—*E. affinis* Deane & Maiden; Grenfell.
Fig.6.—*E. Baeuerleni* F.v.M.; Sugarloaf Mountain.
Fig.7.—*E. rubida* Deane & Maiden; Laurel Hill.

Plate xliv.

Fig.1.—*E. Bosistoana* F.v.M.; Blacktown.
Fig.2.—*E. paniculata* Sm.; Parramatta.
Fig.3.—*E. intertexta* R. T. Baker; Gunbar.
Fig.4.—*E. paludosa* R. T. Baker; Braemar.
Fig.5.—*E. lactea* R. T. Baker; Mt. Kosciusko.
Fig.6.—*E. conica* Deane & Maiden; Girilambone.
Fig.7.—*E. quadrangulata* Deane & Maiden; Mittagong.

Plate xlv.

Fig.1.—*E. hemilampra* F.v.M.; Moss Vale.
Fig.2.—*E. corynocalyx* F.v.M.
Fig.3.—*E. resinifera* Sm.; Parramatta.
Fig.4.—*E. Behriana* F.v.M.; Inglewood, Victoria.

Plate xlvi.

Fig.1.—*E. dealbata* A. Cunn; Narrandera.
Fig.2.—*E. tereticornis* var. *linearis* Baker & Smith; Woodburn.
Fig.3.—*E. maculosa* R. T. Baker; Tarago.
Fig.4.—*E. punctata* DC.; Parramatta.
Fig.5.—*E. Bridgesiana* R. T. Baker; Bungendore.
Fig.6.—*E. goniocalyx* F.v.M.; Monga.

Plate xlvii.

Fig.1.—*E. camphora* R. T. Baker; Heydon's Bog.
Fig.2.—*E. populifolia* Hook.; Nyngan.
Fig.3.—*E. cinerea* F.v.M.; Barber's Creek.
Fig.4.—*E. longifolia* Link & Otto; Parramatta.
Fig.5.—*E. Smithii* R. T. Baker; Monga.

Plate xlviii.

Fig.1.—*E. Maideni* F.v.M.; Barber's Creek.
Fig.2.—*E. pulverulenta* Sm.; Bathurst.
Fig.3.—*E. globulus* Labill.; Jenolan Caves.
Fig.4.—*E. Morrisii* R. T. Baker; Coolabah.
Fig.5.—*E. sideroxylon* A. Cunn.; Tenterfield.
Fig.6.—*E. Rossii* Baker & Smith; Rylstone.

Plate xlix.

Fig.1.—*E. Stuartiana* F.v.M.; Ringwood, Vic.
Fig.2.—*E. pendula* A. Cunn.; Sylvanham.
Fig.3.—*E. polyanthema* Schau.
Fig.4.—*E. salubris* F.v.M.; W.A.
Fig.5.—*E. squamosa* Deane & Maiden; National Park (advanced stage).

Plate l.

Fig.1.—*E. squamosa;* National Park (early stage).
Fig.2.—*E. reduncа* Schau.
Fig.3.—*E. Rodwayi* Baker & Smith; Interlaken, Tas.
Fig.4.—*E.*, sp. nov., R. T. Baker.
Fig.5.—*E. santalifolia* F.v.M.; S.A.

Plate li.

Fig.1.—*E. urnigera* Hook.f.; Mt. Wellington, Tas.
Fig.2.—*E. unialata* Baker & Smith; Hobart.
Fig.3.—*E. fasciculosa* F.v.M.; S.A.
Fig.4.—*E. corynocalyx* F.v.M.; S.A.
Fig.5.—*E. Muelleri* T. B. Moore; Mt. Wellington, Tas.

Plate lii.

Fig.1.—*E. occidentalis* Endl.; W.A.
Fig.2.—*E. Perriniana* F.v.M.; Mt. Kosciusko.
Fig.3.—*E. megacarpa* F.v.M.; W.A.
Fig.4.—*E. leptopoda* Benth.; W.A.

Plate liii.

Fig.1.—*E. elæophora* F.v.M.; Bungendore.
Fig.2.—*E. dumosa* A. Cunn.; Wyalong.

Fig.3.—*E. polybractea* R. T. Baker; Inglewood, Vic.
Fig.4.—*E. oleosa* F.v.M.; Nyngan.
Fig.5.—*E. salmonophloia* F.v.M.; W.A.
Fig.6.—*E. cneorifolia* DC.; Cygnet River, S.A
Fig.7.—*E. gracilis* F.v.M.; Shuttleton.

Plate liv.

Fig.1.—*E. platyphylla* F.v.M.; W.A.
Fig.2.—*E. cornuta* Labill.; W.A.
Fig.3.—*E. gomphocephala* DC.; W.A.
Fig.4.—*E.* sp. nov., R. T. Baker.
Fig.5.—*E. stricta* Sieb.; Wentworth Falls.

Plate lv.

Fig.1.—*E. cosmophylla* F.v.M.; S.A.
Fig.2.—*E. Lehmanni* Preiss; W.A.
Fig.3.—*E. striaticalyx*; W.A.
Fig.4.—*E. loxophleba* Benth.; W.A.
Fig.5.—*E. odorata* Behr; S.A.
Fig.6.—*E. platyphylla* F.v.M.; W.A.
Fig.7.—*E. eudesmioides* F.v.M.; W.A.
Fig.8.—*E. saligna* var. *pallidivalvis* Baker & Smith.

Plate lvi.

Fig.1.—*E. melliodora* A. Cunn.; Bathurst.
Fig.2.—*E. viridis* R. T. Baker; Girilambone.
Fig.3.—*E. Woollsiana* R. T. Baker; Rest Down.
Fig.4.—*E. albens* Miq.; Rylstone.
Fig.5.—*E. hemiphloia* F.v.M.; Parramatta.

Plate lvii.

Fig.1.—*E. acmenioides* Schau.; Parramatta.
Fig.2.—*E. carnea* Baker & Smith; Dunoon.
Fig.3.—*E. hæmastoma* Sm.; Parramatta.
Fig.4.—*E. phlebophylla* F.v.M.; Tunbridge, Tas.

Plate lviii.

Fig.1.—*E. viminalis* Labill.; Moss Vale.
Fig.2.—*E. rostrata* Schlecht.; S.A.
Fig.3.—*E. ovalifolia* R. T. Baker; Rylstone.
Fig.4.—*E. Dawsoni* R. T. Baker; Rylstone.
Fig.5.—*E. fastigata* Deane & Maiden; Monga.
Fig.6.—*E. macrorhyncha* F.v.M.; Rylstone.
Fig.7.—*E. capitellata* Sm.; Cronulla.

Plate lix.

Fig.1.—*E. nigra* R. T. Baker; Woodburn.
Fig.2.—*E. pilularis* Sm.; Parramatta.
Fig.3.—*E. Planchoniana* F.v.M.; Woodburn.
Fig.5.—*E. Fletcheri* R. T. Baker; St. Mary's.

Plate lx.

Fig.1.—*E. Risdoni* Hook f.; Hobart, Tas.
Fig.2.—*E. coccifera* Hook. f.; Mt. Wellington, Tas.
Fig.3.—*E. piperita* Sm.; Parramatta.
Fig.4.—*E. Gunnii* Hook. f.; Interlaken, Tas.
Fig.5.—*E. linearis* A. Cunn.; Mt. Wellington, Tas.
Fig.6.—*E. campanulata* Baker & Smith; Tenterfield.

Plate lxi.

Fig.1.—*E. crebra* F.v.M.; Parramatta.
Fig.2.—*E. melanophloia* F.v.M.; Wee Waa.
Fig.3.—*E. siderophloia* Benth.; Parramatta.
Fig.4.—*E. amygdalina* Labill.; Laurel Hill, N.S.W.

Plate lxii.

Fig.1.—*E. amygdalina* Labill.; Yarra Junction, Vic.
Fig.2.—*E. amygdalina* Labill.; Hobart.
Fig.3.—*E. Luehmanniana* F.v.M.; National Park.
Fig.4.—*E. oreades* R. T. Baker; Lawson.
Fig.5.—*E. Sieberiana* F.v.M.; Mt. Ash.

Plate lxiii.

Fig.1.—*E. coriacea* A. Cunn.; Guy Fawkes.
Fig.2.—*E. Delegatensis* R. T. Baker; Laurel Hill.
Fig.3.—*E. obliqua* L'Hér.; Tasmania.
Fig.4.—*E. dives* Schau.; Rydal.

Plate lxiv.

Fig.1.—*E. obliqua* L'Hér.; Mt. Gambier, S.A.
Fig.2.—*E. Andrewsi* Maiden; Tenterfield.
Fig.3.—*E. phlebophylla* F.v.M.; Tasmania.
Fig.4.—*E. radiata* Sieb.; Monga.
Fig.5.—*E. Macarthuri* Deane & Maiden; Bowral.
Fig.6.—*E. patentinervis* R. T. Baker; Ashfield.
Fig.7.—*E. stellulata* Sieb.; Rydal.

Plate lxv.

Fig.1.—*E. citriodora* Hook.; Parramatta (cultivated).
Fig.2.—*E. apiculata* Baker & Smith; Wentworth Falls

Fig.3.—*E. virgata* Sieb.; St. Mary's, Tas.
Fig.4.—*E. virgata*.
Fig.5.—*E. obtusiflora* DC.; The Spit, Sydney.

Plate lxvi.

Fig.1.—*E. regnans* F.v.M.; Mt. Wellington, Tas.
Fig.2.—*E. Moorei* Maiden & Cambage; Blackheath.
Fig.3.—*E. incrassata* Labill.; Dimboola, Vic.
Fig.4.—*E. acervula* Hook. f.; Hobart, Tas.
Fig.5.—*E. calycogona* Turcz.; Dimboola, Vic.
Fig.6.—*E. uncinata* Turcz.; Dimboola, Vic.
Fig.7.—*E. pulverulenta* Sm.; Bathurst.
Note three cotyledons and leaves in whorls of three.

Plate lxvii.

Fig.1.—*E. tereticornis* Sm.; Parramatta.
Fig.2.—*E. Bosistoana* F.v.M.; Blacktown. (Note three cotyledons, and leaves in pairs.
Fig.3.—*E. Parramattensis* C. Hall; Fairfield.
Fig.4.—*E. Marsdeni*, sp. nov., C. Hall; Toongabbie.
Fig.5.—*E. leucoxylon* F.v.M.; Dimboola, Vic.
Fig.6.—*E. aggregata* Deane & Maiden; Rydal.
Fig.7.—*E. hæmastoma* var. *micrantha*, DC.

Plate lxviii.

Fig.1.—*E. sideroxylon* var. *pallens* Baker & Smith.
Fig.2.—*E. tæniola* Baker & Smith; St. Mary's, Tas.
Fig.3.—*E. acaciæformis* Deane & Maiden; Tenterfield.
Fig.4.—*E.* sp. nov., R. T. Baker.
Fig.5.—*Syncarpia laurifolia* Ten.; Parramatta. (Note the reniform cotyledons, with incipient emargination and flattened petioles. Leaves and stem pubescent.).
Fig.6.—*Angophora lanceolata* Cav.; National Park.
Fig.7.—*E. melanophloia* F.v.M.; Wee Waa; showing peculiar modification of third pair of leaves, occasionally seen in early leaves of Eucalypts, and always bilateral.

Plate lxix.

Examples of Eucalyptus Cotyledons.

Fig.1*a*.—*Angophora lanceolata*.
Fig.1*b*.—*Eucalyptus calophylla*.
Fig.2.—*E. citriodora*.
Fig.3.—*E. corymbosa*.
Fig.4.—*E. lævopinea*.
Fig.5.—*E. dumosa*.
Fig.6.—*E. marginata*.
Fig.7.—*E. Planchoniana*.
Fig.8.—*E. acmenioides*.
Fig.9.—*E. piperita*.

Fig.10.—*E. Luehmanniana.*
Fig.11.—*E. amygdalina*, Vic.
Fig.12.—*E. microcorys.*
Fig.13.—*E. resinifera.*
Fig.14.—*E. Stuartiana.*
Fig.15.—*E. affinis.*
Fig.16.—*E. rubida.*
Fig.17.—*E. corynocalyx.*
Fig.18.—*E. elæophora.*
Fig.19.—*E.* sp. nov., R. T. Baker.
Fig.20.—*E. gomphocephala.*
Fig.21.—*E. cornuta.*
Fig.22.—*E. calycogona.*
Fig.23.—*E. pendula.*
Fig.24.—*E. salubris.*
Fig.25.—*E. squamosa.*

A, diagrammatic transverse section of seed of *E. corymbosa; t*, testa; *r*, radicle; c^1, c^2, cotyledons.

B, diagrammatic transverse section of seed of *E. globulus;* c^1, c^1, halves of one cotyledon; c^2, c^2, halves of the other.

C, diagrammatic transverse section of seed of *E. squamosa.*

D, diagram of reduction by emargination. The whole represents a cotyledon of *E. corymbosa;* remove *a* for *E. Planchoniana;* remove *ab* for *E. elæophora;* remove *abcee* for *E. squamosa.*